BPA Ross
ROD & AR OU 2
9/29/93

DECLARATION

BONNEVILLE POWER ADMINISTRATION
ROSS COMPLEX
VANCOUVER, WASHINGTON
RECORD OF DECISION

SITE NAME AND LOCATION

Bonneville Power Administration, Ross Complex
Vancouver, Washington

STATEMENT OF PURPOSE

This decision document presents the selected remedial action for Operable Unit B (OUB), one of two operable units, of the Bonneville Power Administration (BPA) Ross Complex Superfund site in Vancouver, Washington. The remedies selected in this decision document were developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP). This Record of Decision is based on the administrative record for this site.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The selected remedies for Operable Unit B (OUB) address the risk posed by the soil contamination at the Fog Chamber Dump Trench Area 1 by capping and containing the contaminated soils and by requiring institutional controls at Trench Area 2. OUB consists of Fog Chamber Dump Trench Areas 1 and 2, the Cold Creek Fill Area, shallow and deep groundwater, and surface water and sediments in Cold and Burnt Bridge Creeks.

Remedial action is required at the Fog Chamber Dump Trench Areas 1 and 2.

The major components of this ROD are:

- Capping the Fog Chamber Dump Trench Area 1 plus Institutional Controls, and;

- Institutional Controls at the Fog Chamber Dump Trench Area 2.

No Action is required for surface water and sediments in Cold Creek and Burnt Bridge Creek or for the Cold Creek Fill Area. There will be groundwater monitoring in the perched shallow water table and deep aquifer.

DECLARATION

The selected remedies are protective of human health and the environment, comply with Federal and State requirements that are legally applicable or relevant and appropriate requirements to the remedial action and are cost-effective. These remedies use permanent solutions and alternative treatment technology to the maximum extent practicable for this site. However, because treatment was not found to be practicable, these remedies do not satisfy the statutory preference for treatment as a principal element of the remedy. The size of the trench areas and the nature of the contamination preclude a remedy in which contaminants could be excavated and treated effectively.

A five year review will be required at the Fog Chamber Dump Trench Area 1 and 2 and for groundwater since hazardous substances will remain on-site above health-based levels.

David Dunahay   Sept 29, 1993

David Dunahay
Bonneville Power Administration
Ross Complex Manager

Date

Signature sheet for the foregoing Operable Unit B, Bonneville Power Administration, Ross Complex Record of Decision between the U.S. Department of Energy, Bonneville Power Administration, Ross Complex and the U.S. Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Charles Findley 9-29-3

for Gerald A. Emison Date
Acting Regional Administrator, Region 10
United States Environmental Protection Agency

Signature sheet for the foregoing Operable Unit B, Bonneville Power Administration, Ross Complex Record of Decision between the U.S. Department of Energy, Bonneville Power Administration, Ross Complex and the U.S. Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Carol L. Fleskes 9/27/93

Carol Fleskes, Program Manager
Toxics Cleanup Program
Washington State Department of Ecology

Date

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DECISION SUMMARY

1.0 INTRODUCTION

The Decision Summary provides a condensed description of the site-specific factors and analysis that led to the selection of the remedy for Operable Unit B (OUB) at the Bonneville Power Administration, Ross Complex Superfund site, beginning with the early identification and characterization of the problem (documented in the remedial investigation (RI)), proceeding through identification and evaluation of candidate remedial alternatives (documenting the feasibility study (FS)), and concluding with the remedy selected in this Record of Decision (ROD). The involvement of the public throughout the process is also described, along with the environmental programs and regulations that relate or direct the overall site remedy. The way in which the selected remedy meets Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the State of Washington Model Toxics Control Act (MTCA) requirements are also documented.

2.0 SITE LOCATION AND DESCRIPTION

2.1 SITE LOCATION

The BPA Ross Complex (referred to hereafter as the Site) consists of a 235-acre tract on the eastern side of U.S. Highway 99 and is bordered to the north by Cold Creek Canyon (Cold Creek), a Burlington Northern Railroad right-of-way, NE Minnehaha Street, and to the east and south by a residential neighborhood. Burnt Bridge Creek borders the Site to the southwest and west, and Highway 99 and Interstate 5 border the Site to the west (Figure 1). The Site address is 5411 NE Highway 99, Vancouver, Washington which is located in Clark County. The primary supply of drinking water in the Vancouver area is obtained from the Troutdale aquifer and is distributed by Clark County PUD through well fields. The well fields are located both hydraulically upgradient and downgradient of the Site. Well field #3 is located immediately downgradient of the Site. Private wells are located within one mile surrounding the Site.

The Site is located approximately 2.7 miles north of the Columbia River and 1.7 miles east of Vancouver Lake. Two streams border the Site, with Cold Creek forming the north border of the Site and Burnt Bridge Creek bordering the southwestern side of the Site. Cold Creek, a tributary to Burnt Bridge Creek, flows into Burnt Bridge Creek just west of the Site. Burnt Bridge Creek flows into Vancouver Lake (Figure 1). The location of the creeks in relation to the Site is shown in Figure 2. Vancouver Lake is used for recreation purposes such as boating, swimming and fishing. The site does not lie within a 100-year flood plain. In the Vancouver area, the Troutdale aquifer is the primary supply of drinking water.

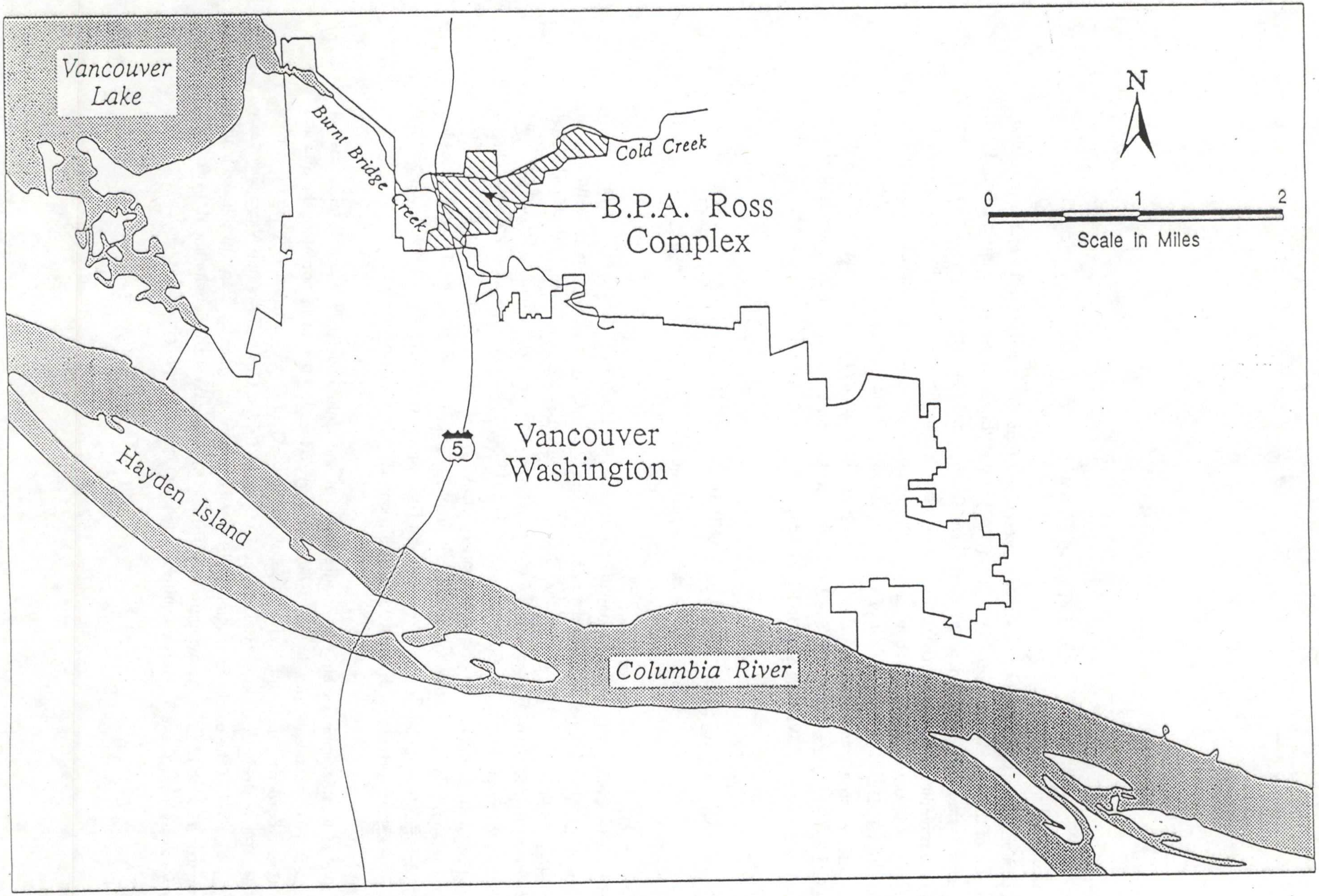


Figure 1. Site Location Map

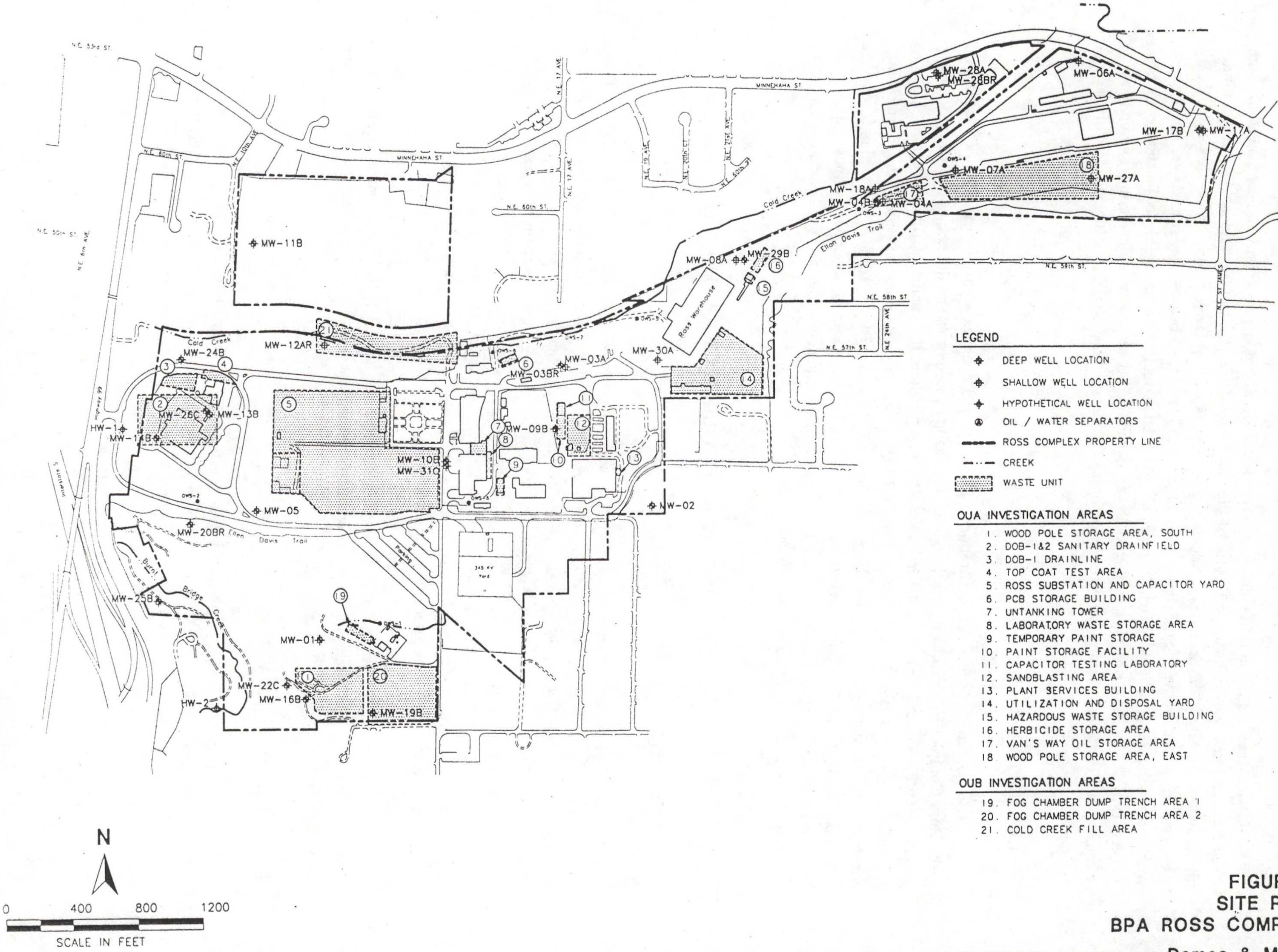


FIGURE 2
SITE PLAN
BPA ROSS COMPLEX

Dames & Moore

Job No. 06737-012-005

Census tract information for the Vancouver area indicates moderate-density human habitation south of the Site, and low density habitation north of the Site. Approximately 18,000 residents live within a one-mile radius of the Site. This includes residents and businesses with workers occupying the area immediately to the east of the Site between St. Johns Ave. and St. James, residents between St. Johns Ave. and 19th St. (southeast of the Site), an area which includes several schools and churches; residents inhabiting the area between 19th St. and Leverich Park to the southwest of the Site (including a trailer park adjoining the Site boundary) and residents inhabiting the area north of the Site between the Cold Creek drainage and Minnehaha Avenue.

2.2 CURRENT LAND USE

The Bonneville Power Administration (BPA) owns and operates a power distribution center known as the Ross Complex in Vancouver, Washington. The facility coordinates and distributes hydroelectric power generated by the Federal Columbia River Power System throughout the Pacific Northwest region. Since its construction in 1939, the Ross Complex has provided research and testing facilities; and maintenance, construction, operations, and waste handling and storage facilities for BPA. Research and testing focuses on evaluation of the durability of electrical storage and transmission equipment under various climatic and weather conditions. Equipment stored, maintained and repaired includes transformers, bushings, and other electrical transmission and storage equipment.

3.0 SITE HISTORY AND ENFORCEMENT ACTIONS

3.1 SITE HISTORY

The Site is an active facility that has been owned and operated by the Bonneville Power Administration (BPA) since 1939 to distribute hydroelectric power generated from the Columbia River to regions throughout the Pacific Northwest. Since its construction, the Site has provided research and testing facilities, maintenance construction operations, and waste storage and handling operations for BPA. Maintenance activities at the Ross Complex have routinely involved handling transformer oils containing polychlorinated biphenyls (PCBs), and organic and inorganic compounds associated with the storage of preserved wood transmission poles, paints, solvents, and waste oils. Testing and laboratory activities include the use of heavy metals (such as mercury) and other organic and inorganic compounds.

The waste units investigated in the PA/SI, OUA RI/FS, and OUB RI/FS are primarily the result of past waste handling practices at the Ross Complex. Some of these areas are no longer active; others continue to be used in current operations.

3.2 INITIAL INVESTIGATIONS

Five investigations were conducted at the Site between 1986 and 1990: a Preliminary Assessment (PA 1986), a Site Investigation (SI 1988), a soil gas survey and ground-water quality assessment (Weston, 1989), a preliminary hydrogeologic investigation (Dames & Moore, 1989), and a Vancouver Well Field Special

Survey (E&E, 1990). BPA has also conducted numerous individual sampling programs in various areas of the Site. The findings of these investigations are summarized in detail in the "Remedial Investigation Report, Operable Unit A, Bonneville Power Administration, Ross Complex" dated May 15, 1992 and the "Remedial Investigation Report, Operable Unit B, Bonneville Power Administration, Ross Complex" dated March 19, 1993.

3.3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS)

The Site was listed on the National Priorities List (NPL) in November 1989 based on the presence of volatile organic compounds (VOCs) in groundwater and the Site's proximity to the City of Vancouver's drinking water supply. As a result of the listing, pursuant to a Federal Facility Agreement (FFA) signed by BPA, EPA, and the Washington Department of Ecology (Ecology) on May 1, 1990, BPA conducted a Remedial Investigation/Feasibility Study (RI/FS) to determine the nature and extent of contamination at the site and to evaluate alternatives for the cleanup of contaminated areas. The RI field investigation began in the summer of 1991 and included the collection and chemical analysis of soil, surface water, sediment, and groundwater samples. A total of twenty one individual areas of concern or "waste units" were identified for investigation based on historical chemical handling, storage and disposal practices and the results of previous investigations (Figure 2). The waste units investigated included:

1. Fog Chamber Dump Trench Areas 1 and 2
2. Wood Pole Storage Area South
3. DOB-1 Drain Line
4. DOB-2 Drainfield
5. Top Coat Test Area
6. Capacitor Testing Lab
7. Paint Storage Facility
8. Plumbing Shop
9. Sandblasting Area
10. Van's Way Oil Storage Area
11. Wood Pole Storage Area East
12. Ross Substation and Capacitor Yard
13. Utilization and Disposal Yard
14. Hazardous Waste Building
15. Herbicide Storage Area
16. Untanking Tower
17. Laboratory Waste Storage Area
18. PCB Storage Area
19. Cold Creek Fill
20. Oil/Water Separators (8)
21. Temporary Storage Area

Initially the RI was designed to address the entire Site but during the summer of 1991, BPA, EPA and Ecology decided that the Site would be divided into two separate operable units (Units A and B) to facilitate the CERCLA process. Operable Unit A is the investigation of soils in 19 of the 21 waste units, the Ellen Davis Trail, and the possible exposure from airborne contamination. The 19 waste units evaluated in Operable Unit A include: Wood Pole Storage Area South, DOB-2 Drainfield, DOB-1 Drain Line, PCB Storage Area, Capacitor Testing Lab, Hazardous Waste Building, Top Coat Test Area, Untanking Tower, Laboratory Waste Storage Area, Van's Way Oil Storage Area, Paint Storage Facility, Wood Pole Storage Area East, Plumbing Shop, Herbicide Storage Area, Ross Substation and Capacitor Yard, Oil/Water Separators (8), Utilization and Disposal Yard, Sandblasting Area, and the Temporary Storage Area. An investigation of the Ellen Davis Trail (where the trail passes through the Site) was performed to evaluate potential risks to area residents who use the trail for recreational purposes. Based on the evaluation of all these areas, remedial action was required at the Wood Pole Storage Area East, the Ross Substation and Capacitor Yard and the Capacitor Testing Lab, as described in the OUA ROD. The OUA ROD was signed on May 6, 1993 by EPA, BPA and Ecology.

This ROD addresses OUB. The Operable Unit B Remedial Investigation focused on characterization of subsurface soils in three areas of concern: the Fog Chamber Dump Trench Areas 1 and 2 and the Cold Creek Fill Area. The investigation also included characterization of the shallow perched water table and deep groundwater aquifer beneath the Site, and surface water and sediment in Cold Creek and Burnt Bridge Creek. Field activities completed in the summer of 1992 to complete site characterization for OUB included the installation of additional monitoring wells, continued groundwater monitoring, and surface water and sediment monitoring in Cold Creek.

3.3.1 Fog Chamber Dump

Trench Area 1

Trench Area 1 in the Fog Chamber Dump consisted of an open pit dump located in the present site of the Fog Chamber Test Facility. The Fog Chamber Dump is the only confirmed area on the Ross Complex where spent capacitors containing PCB oils have been disposed along with other assorted incidental solid wastes such as wood pallets, waste paper, and glass insulators. Reportedly these wastes were set on fire and allowed to burn. Historical aerial photographs indicate that an open pit approximately 12 feet by 120 feet with a depth of 20 feet existed between 1956 and 1960. A second shallower disposal area was identified near the pit location and is approximately 150 feet by 15 feet with a depth of 15 feet. A deep aquifer exists in the area of the Fog Chamber Dump and is approximately 150 feet below ground surface.

Trench Area 2

Aerial photographs dated 1942 and July 21, 1951, initially revealed the presence of six parallel features in Trench Area 2 (located southeast of Trench Area 1) and appeared to represent closed spaced backfilled excavations or dirt roadways. A 1955 aerial photograph showed active grading areas and the presence of fill material which was most likely from the Ross Substation and Capacitor Yard and the 345 kV yard.

3.3.2 Cold Creek Fill Area

The Cold Creek Fill Area is a former landfill in Cold Creek Valley along the northern boundary of the Ross Complex. This fill area was used by BPA from about 1960 to 1986. Cold Creek runs through a culvert covered by fill to a depth of 30 to 80 feet. Fill materials came primarily from past construction activities on the Complex. Potentially contaminated fill included excavated soils from the Dittmer Building construction (including DOB-1 and DOB-2 Sanitary Drainfield) and from graded material potentially contaminated with oils and PCBs associated with paving of the Utilization and Disposal Yard. Evidence of spent sandblasting materials potentially containing heavy metals has also been found.

Another potential source of fill may have been from the grading of the Top Coat Test Area. The excavated soils may have been contaminated with PCP formulations and metals used to test wood poles at the

Top Coat Test Area. A review of historical air and ground photographs and interviews with BPA personnel indicate that the base of the fill was likely engineered.

4.0 COMMUNITY RELATIONS

Following the completion of the Site Investigation in July 1988, three fact sheets were mailed to the public in April and May 1990 which described the listing of the Site on the National Priorities List (NPL) and the CERCLA process and associated schedule that BPA would undertake.

On May 1, 1991, a community relations plan (CRP) was prepared by BPA's Community Relations Group in accordance with CERCLA, as amended by SARA. The CRP included establishing information repositories and communication pathways to disseminate information. Information repositories are located at both the Ross Complex and in the Vancouver Regional Library, 1007 East Mill Plane Boulevard, Vancouver, Washington 98663.

4.1 COMMUNITY RELATIONS DURING THE RI/FS

An administrative record was established to provide the basis for selection of the remedial action in accordance with section 113 of CERCLA. The administrative record is available for public review at the Ross Complex or the Vancouver Regional Library. During the RI/FS, BPA issued a press release and five additional fact sheets. The chronology of the community relations is listed below.

- May 22, 1990 — A scoping meeting was held to provide information to the public and hear concerns about environmental conditions at the site.
- July 1990 — Fact sheet No. 4 described the results of the May scoping meeting.
- March 1991 — Fact sheet No. 5 described chronology of events and the work plan for the RI/FS.
- May 1991 — Fact sheet No. 6 described the RI and FS programs and current site work.
- August 1991 — Fact sheet No. 7 described status of the RI field work.
- August 1992 — A Proposed Plan for Remedial Action of OUA was mailed to the public. The plan described proposed remedial actions and selected remedies for OUA soils.
- September 1992 — A public meeting was held to present the findings of the RI/FS for OUA and the selected remedial alternatives outlined in the Proposed Plan for OUA.
- May 1992 — Fact sheet No. 8 defined Operable Units A and B, discussed OUA RI and risk assessment findings, and activities planned for the summer of 1992.

- May 1993 — Fact sheet No. 9 described the results of the RI for OUA and OUB, that groundwater was not a public threat and gave advance notice of the upcoming July 1993 public meeting.
- June 1993 — Proposed Plan for OUB Remedial Action of OUB was mailed to the public. The plan described the results of the OUB RI/FS, proposed remedial alternatives and selected remedies for OUB soil groundwater, surface water and sediment.
- July 1993 — A Public Meeting was held to present the findings of the RI/FS for Operable Unit B and the selected remedial alternatives outlined in the Proposed Plan for OUB.

4.2 COMMUNITY RELATIONS TO SUPPORT SELECTION OF REMEDY

The public was given the opportunity to participate in the remedy selection process in accordance with sections 117 and 113(k)(2)(B) of CERCLA. The Proposed Plan for Operable Unit B, which summarized the alternatives evaluated and presented the preferred alternative, was mailed to approximately 800 interested parties on June 24, 1993. BPA provided public notice through display ads in the Columbian and Oregonian on June 22, 1993 to explain the Proposed Plan, list the public comment period, and announce the public meeting. Media coverage was also provided in the form of local newspaper articles which appeared on June 2 and 6, 1993 and cable television news coverage on Channel 25 on June 1 and July 9, 1993.

A 30-day public comment period was held from June 25, 1993 to July 26, 1993. Approximately 20 people attended a public meeting, which was held on July 8, 1993 at the Ross Complex, DOB Auditorium. No verbal comments were received at the public meeting and three written comments are included in the attached Responsiveness Summary.

Copies of the ROD and the Responsiveness Summary will be placed in the administrative record and in the information repositories.

5.0 SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

The OUB RI evaluated the nature and extent of contamination in subsurface soils in the Fog Chamber Dump Trench Areas 1 and 2 and in the Cold Creek Fill Area. The OUB RI also included evaluation of the shallow perched water table and the deep aquifer beneath the Site, and surface water and sediments in Cold Creek and Burnt Bridge Creek. Results from the baseline risk assessment indicate that a CERCLA remedial action is necessary for contaminated subsurface soils in the Fog Chamber Dump Trench Area 1. High levels of PCBs and metals were found throughout subsurface soils in Trench Area 1, up to 20 feet deep in isolated areas. Although the risk assessment indicated that soils in Trench Area 2 do not represent an unacceptable risk under CERCLA, soils in the Fog Chamber Dump Trench Area 2 contained elevated levels of lead and other metals above the state cleanup levels in areas which are associated with solid waste debris. Site groundwater quality does not pose an unacceptable CERCLA risk; however, volatile organic compounds found in two on-site wells are slightly above the EPA Maximum Contaminant Level (MCL) for 1,1-dichloroethene (DCE) and 1,1,1-trichloroethane (TCA). The final remedial action selected in this ROD requires capping and

institutional controls to both reduce surface water infiltration and contaminant migration, and to prevent human exposure to the subsurface contaminants.

The final selected remedies include: (1) minimal functional standards (MFS) cap with institutional controls in the Fog Chamber Dump Trench Area 1, (2) institutional controls in the Fog Chamber Dump Trench Area 2, and (3) continued monitoring of volatile organic compounds in groundwater.

There were no unacceptable risks associated with the Cold Creek Fill soils, Cold Creek and Burnt Bridge Creek sediments, or surface water under CERCLA or MTCA; therefore, no further action will be required for these areas.

6.0 SUMMARY OF SITE CHARACTERISTICS

6.1 PHYSICAL SETTING

The Site is located on an ancient alluvial terrace. Creeks and streams in the area have been cutting into the terrace deposits, creating incised channels. Elevations across the Site range from greater than 250 feet above mean sea level to approximately 40 feet above mean sea level. The surface gradient generally slopes to the west across the Site, with localized steep slopes toward Cold Creek to the north and Burnt Bridge Creek to the southwest (Figure 1). Two streams border the Site, with Cold Creek forming the north border of the Site and Burnt Bridge Creek bordering the southwestern side of the Site. Cold Creek, a tributary to Burnt Bridge Creek, flows into Burnt Bridge Creek just west of the Site. Burnt Bridge Creek flows into Vancouver Lake (Figure 1). The location of the creeks in relation to the Site is shown in Figure 2. Site stormwater runoff is directed through oil/water separators and then drains to either Cold Creek or Burnt Bridge Creek.

No wetlands were found at the Site. Several wetlands were observed west of the Site along Burnt Bridge Creek near Vancouver Lake. These include a palustrine-emergent wetland and a palustrine open-water wetland that are hydrologically connected to Burnt Bridge Creek. There were no threatened or endangered species observed at the Site or adjacent to the site.

A site survey to determine the presence of historic structures or features was performed in 1987. Four sites were found to be eligible for historic nomination; the Control House, Oil House, Switching Yard and the landscaping around the Control House and Oil House. None of the sites have been nominated and no site has been listed in national, state, or local preservation registers. The CERCLA action will not affect any of these sites.

6.2 GEOLOGICAL SETTING

The Site is located on terraces that range in elevation from 40 feet to more than 250 feet above mean sea level (msl). The western two-thirds of the Site occupies an east-west trending ridgeline. The ridgeline slopes to the west with a moderately steep flank slope to the north towards Cold Creek. It also has a moderately steep slope to the southwest towards Burnt Bridge Creek. The eastern third of the Site occupies a valley averaging about 240 feet above msl with gently sloped sides. This valley drains to the west into Cold Creek.

Geologically, the Site rests on Pleistocene alluvial deposits in the Fourth Plains area of Clark County (Walsh et al, 1987). The Pleistocene deposits consist of 110 to greater than 177 feet of unconsolidated Pleistocene-aged sands, silts, and clays underlain by moderately consolidated Upper Troutdale Formation silty, sandy, or clayey gravels. The Upper Troutdale Formation underlies the Pleistocene deposits. The Upper Troutdale Formation is characterized by gravelly deposits as opposed to finer grained deposits of the Pleistocene-aged materials. The contact between the Troutdale and the younger Pleistocene sediments appears to be an erosional unconformity. The unconformity is expressed by a change in elevation of the contact across the Site. The subcrop or surface of the Troutdale Formation is encountered in borings ranging from 14 to 110 feet msl or 62 to 164 feet below ground surface (bgs). The Upper Troutdale Formation consists of unconsolidated to moderately consolidated silty, sandy, and clayey gravels. The Upper Troutdale Formation materials appear to be well drained except for the clayey gravel units.

The Site is mantled by Lauren-Sifton-Wind River soils resting on nearly level to gently rolling terraces typical of southwestern Clark County. The soils are gravelly and medium to coarse-grained, have a large available water capacity, and are excessively drained. The soil in the southwestern portion of the Site consists of Wind River sandy loam, which extends over approximately 30 percent of the Site. This soil is excessively drained and exhibits moderately high permeability. In active areas on site, the upper soils are compacted and are less permeable than the loose undisturbed soils.

6.3 HYDROGEOLOGIC SETTING

Two important aquifers exist in the Portland-Vancouver area, the Pleistocene alluvial deposits and the Upper Troutdale Formation. The Pleistocene alluvial deposits are used for domestic and some irrigation supplies. The Pleistocene deposits yield up to 1,000 gallons per minute (gpm) or more from the coarser sand and gravel units; where deposits are thin and less permeable, perched or semi-perched ground-water zones may occur. Regionally, many domestic and irrigation water supply wells were completed in the Pleistocene alluvial deposits in the area between Burnt Bridge Creek and Salmon Creek (north of Burnt Bridge Creek). The Site is within the Burnt Bridge Creek/Salmon Creek Area.

The eastern portion of the Site overlies a sequence of unconsolidated alluvial terrace sediments which contains shallow perched ground water. The depth to the shallow groundwater varies across the Site from less than 10 feet at the extreme eastern side of the Site to greater than 100 feet in the central portion of the Site. Saturated thickness of the perched water table also varies considerably from 50 feet to less than 10 feet. Potential groundwater yield from the perched water table beneath the site are relatively low due to highly variable hydraulic conductivity both vertically and horizontally and the limited extent of saturated units. Hydraulic conductivity was measured to vary between 0.6 and 90 ft/day. East of the site, the shallow water table provides supplies to wells in some areas. The western quarter of the site contains no shallow perched groundwater due to the absence of low permeability strata within the alluvial sediments. The shallow water table is perched above the regional aquifer and flows northwest and discharges directly to Cold Creek or emanates as springs on the banks of the creek and flows into Cold Creek. Based on the information collected in the RI, there is insufficient yield in the perched water table beneath the site and therefore cannot be used as a drinking water source.

Underlying the alluvial sediments beneath the entire Site is the Troutdale Formation, a partially cemented sand and gravel sequence which contains a regional aquifer. In the Vancouver area, the Troutdale aquifer is productive and is the primary supply of water. City of Vancouver water supply wells located west of the city produce as much as 3,000 gallons per minute. The deep Troutdale aquifer on-site flows south westward towards Lake Vancouver and the Columbia River which is consistent with the regional flow conditions as presented by the United States Geological Survey. Burnt Bridge Creek is perched above and recharges the deep aquifer. The thickness of the upper Troutdale in the vicinity of the Site is estimated to be generally greater than 50 feet. The transmissivity of the aquifer beneath the site is estimated to range between less than 5,000 ft/day on the eastern portion of the Site to greater than 10,000 ft/day beneath the western portion of the Site.

Site drainage is either over land or by sewer to one of the two confluent creeks, Cold Creek to the north and northwest and Burnt Bridge Creek to the southwest and west. Cold Creek, through portions and upstream of the Site, is contained in a culvert which through a portion of the Site is a covered by a fill area. Cold Creek is experiencing erosion down valley from the culvert outlet. It is characterized as gaining baseflow across the Site probably due to drainage of a perched water table in the eastern portion of the Site.

Burnt Bridge Creek flows through an older, less altered valley without evidence of erosion at the Site. It exhibits apparent seasonal losses in flow along the western edge of the Site into coarse grained alluvium and underlying geologic units. The hydrogeologic properties of the Pleistocene deposits and degree of hydraulic connection between the creek and the aquifer are not characterized. Burnt Bridge Creek may seasonally receive bank seepage from the Site but this contribution to the flow in the Creek is not annually sustained as it is in Cold Creek.

6.4 NATURE AND EXTENT OF CONTAMINATION

The Operable Unit B Remedial Investigation included characterization of subsurface soils in three areas of concern: the Fog Chamber Dump Trench Areas 1 and 2 and the Cold Creek Fill Area. The investigation also included characterization of the shallow perched water table and deep groundwater aquifer beneath the Site, and of surface water and sediment in Cold Creek and Burnt Bridge Creek. The subsurface soil, groundwater, surface water, and sediment samples were analyzed for volatile organic compounds (VOCs), base/neutral/acid semi-volatile organic compounds (BNAs), high molecular weight polynuclear aromatic hydrocarbons (HPAHs), metals, polychlorinated biphenyls (PCBs), pesticides, and/or herbicides. Selected subsurface soils in the Fog Chamber Dump, Trench Area 1, were also analyzed for dioxins and furans (PCDDs/PCDFs). Tables 1 through 5 summarize the concentration ranges of organic contaminants and selected metals detected in soils, groundwater, surface water, and sediment. Table 6 lists the cleanup levels selected for OUB soils and groundwater. Additional metals were detected, but their presence did not exceed risk-based criteria or naturally-occurring background concentrations.

Table 1
Summary of Laboratory Results
Soil
Operable Unit B

Concentrations expressed in mg/kg.

Depth	Analyte	Concentration Range	Frequency of Detection
Fog Chamber Dump-Trench Area 1			
Surface	Antimony	R	0 / 0
	Aroclor 1254	**0.2 - 24**	**4 / 4**
	Arsenic	1.2 - 3.5	4 / 4
	Barium	151 - 189	4 / 4
	Benzo(a)anthracene	0.006 - 0.13	4 / 4
	Benzo(a)pyrene	0.008 - 0.019	4 / 4
	Benzo(b)fluoranthene	ND - 0.016	3 / 4
	Benzo(g,h,i)perylene	0.008 - 0.016	4 / 4
	Benzo(k)fluoranthene	0.006 - 0.011	4 / 4
	Cadmium	ND	0 / 4
	Chromium	11.7 - 22.2	4 / 4
	Chrysene	0.01 - 0.021	4 / 4
	Copper	17.9 - 92.9	4 / 4
	Dibenzo(a,h)anthracene	0.002 - 0.006	4 / 4
	Fluoranthene	0.019 - 0.032	4 / 4
	Indeno(1,2,3-cd)pyrene	0.009 - 0.012	4 / 4
	Lead	13.3 - 38.9	4 / 4
	Mercury	ND	0 / 4
	Nickel	12.9 - 16.2	4 / 4
	Pentachlorophenol	ND - 0.39	2 / 4
	Phenanthrene	ND - 0.083	1 / 4
	Pyrene	0.016 - 0.028	4 / 4
	Silver	R	0 / 0
	Total carcinogenic HPAHs	0.072 - 0.096	4 / 4
	Total Xylenes	ND - 0.007	1 / 4
	Zinc	66.5 - 169	4 / 4
Subsurface	1,1,2,2-Tetrachloroethane	ND - 0.012	1 / 24
	2,4,5-T	ND - 0.018	1 / 23
	2,4-D	ND - 0.01	1 / 23
	2-Methylnaphthalene	ND - 0.09	1 / 24
	Acenaphthene	ND - 0.06	1 / 24
	Acenaphthylene	ND - 0.024	1 / 24
	Anthracene	ND - 0.54	2 / 24
	Antimony	**ND - 83.5**	**30 / 35**
	Aroclor 1254	**ND - 4200**	**9 / 49**
	Aroclor 1260	**ND - 12000**	**5 / 49**
	Arsenic	**0.48 - 52.3**	**52 / 52**
	Barium	64.5 - 2120	52 / 52
	Benzo(a)anthracene	ND - 3.8	8 / 52
	Benzo(a)pyrene	ND - 1.9	9 / 52
	Benzo(b)fluoranthene	ND - 2.6	8 / 52
	Benzo(g,h,i)perylene	ND - 2.1	7 / 52
	Benzo(k)fluoranthene	ND - 1.4	8 / 52
	Bis(2-ethylhexyl)phthalate	ND - 0.024	1 / 24
	Butylbenzylphthalate	ND - 0.22	1 / 24
	Cadmium	ND - 21.6	15 / 52
	Carbazole	ND - 0.45	2 / 24
	Carbofuran	ND - 2.4	1 / 24
	Chlorpropham	ND - 1.2	2 / 24
	Chromium	5.7 - 311	52 / 52
	Chrysene	ND - 4.5	9 / 52
	Copper	**ND - 4590**	**28/52**
	Zinc	28.3 - 4730	52 / 52

Depth	Analyte	Concentration Range	Frequency of Detection
Fog Chamber Dump-Trench Area 1			
Subsurface	Di-n-butylphthalate	ND - 0.12	1 / 24
	Dibenzo(a,h)anthracene	ND - 0.6	7 / 52
	Dibenzofuran	ND - 0.036	1 / 24
	Diuron	ND - 048	2 / 24
	Fluoranthene	ND - 7.5	8 / 52
	Fluorene	ND - 0.64	4 / 52
	Indeno(1,2,3-cd)pyrene	ND - 2.2	7 / 52
	Lead	**2.2 - 4210**	**52 / 52**
	Mercury	ND - 1.6	6 / 52
	Naphthalene	ND - 0.014	1 / 24
	Nickel	9.5 - 262	52 / 52
	Phenanthrene	ND - 3.9	4 / 24
	Pyrene	ND - 9.5	15 / 52
	Silver	ND - 182	9 / 37
	Toluene	ND - 0.072	2 / 24
	Total carcinogenic HPAHs	ND - 19.1	12 / 52
	Total Xylenes	ND - 0.13	2 / 24
	PCDD/PCDF	ND - 0.005	8 / 9
Fog Chamber Dump-Trench Area 2			
Subsurface	Acetone	ND - 0.024	1 / 16
	Antimony	**ND - 152**	**3 / 16**
	Aroclor 1254	ND - 0.18	2 / 16
	Aroclor 1260	ND - 0.64	2 / 16
	Arsenic	**0.58 - 42.7**	**16 / 16**
	Barium	103 - 5580	16 / 16
	Benzo(a)anthracene	ND - 0.44	3 / 16
	Benzo(a)pyrene	ND - 0.52	4 / 16
	Benzo(b)fluoranthene	ND - 0.52	5 / 16
	Benzo(g,h,i)perylene	ND - 0.29	2 / 16
	Benzo(k)fluoranthene	ND - 0.3	2 / 16
	Bis(2-ethylhexyl)phthalate	ND - 0.022	1 / 16
	Cadmium	ND - 37	5 / 16
	Chlorpropham	ND - 1.1	1 / 16
	Chromium	7.9 - 160	16 / 16
	Chrysene	ND - 0.39	3 / 16
	Copper	**16 - 55600**	**16 / 16**
	Dibenzo(a,h)anthracene	ND - 0.074	2 / 16
	Fluoranthene	ND - 0.47	2 / 16
	Fluorene	ND - 0.004	1 / 16
	Indeno(1,2,3-cd)pyrene	ND - 0.28	2 / 16
	Lead	3.7 - 16700	16 / 16
	Mercury	ND - 9.5	3 / 16
	Methylene chloride	ND - 0.67	2 / 16
	Nickel	11.8 - 139	16 / 16
	Phenanthrene	ND - 0.019	1 / 16
	Pyrene	ND - 0.3	13 / 16
	Silver	ND - 8.2	1 / 16
	Toluene	ND - 0.05	6 / 16
	Total carcinogenic HPAHs	ND - 2.814	5 / 16
	Total Xylenes	ND - 0.012	4 / 16
	Zinc	**43.3 - 24000**	**16 / 16**

Table 1
Summary of Laboratory Results
Soil
Operable Unit B

Concentrations expressed in mg/kg.

Depth	Analyte	Concentration Range	Frequency of Detection
Cold Creek Fill Area			
Surface	Antimony	ND	0 / 7
	Aroclor 1248	ND - 3.8	3 / 9
	Aroclor 1254	ND - 0.46	3 / 9
	Aroclor 1260	ND - 0.6	3 / 9
	Arsenic	ND - 41.2	6 / 9
	Barium	91.9 - 598	9 / 9
	Benzo(a)anthracene	ND - 0.047	8 / 9
	Benzo(a)pyrene	0.002 - 0.059	9 / 9
	Benzo(b)fluoranthene	0.003 - 0.054	9 / 9
	Benzo(g,h,i)perylene	ND - 0.045	8 / 9
	Benzo(k)fluoranthene	ND - 0.027	7 / 9
	Bis(2-ethylhexyl)phthalate	ND - 0.44	1 / 9
	Cadmium	ND	0 / 9
	Chromium	9 - 80.2	9 / 9
	Chrysene	ND - 0.06	7 / 9
	Copper	21.9 - 1930	9 / 9
	Di-n-butylphthalate	ND - 0.024	1 / 9
	Dibenzo(a,h)anthracene	ND - 0.011	4 / 9
	Fluoranthene	ND - 0.11	8 / 9
	Fluorene	ND - 0.006	2 / 9
	Indeno(1,2,3-cd)pyrene	ND - 0.058	7 / 9
	Lead	3.2 - 95.9	9 / 9
	Mercury	ND - 0.57	2 / 9
	Nickel	10.8 - 30.3	9 / 9
	Pentachlorophenol	ND - 0.56	1 / 9
	Phenanthrene	ND - 0.12	3 / 9
	Pyrene	ND - 0.098	8 / 9
	Silver	ND	0 / 4
	Total carcinogenic HPAHs	0.005 - 0.357	9 / 9
	Total Xylenes	ND - 0.007	1 / 9
	Zinc	45.2 - 432	9 / 9

Depth	Analyte	Concentration Range	Frequency of Detection
Cold Creek Fill Area			
Subsurface	2-Methylnaphthalene	ND - 0.85	1 / 20
	4-Methyl-2-pentanone	ND - 0.012	2 / 20
	4-Methylphenol	ND - 1.6	1 / 20
	Acenaphthene	ND - 0.82	1 / 20
	Acetone	ND - 0.071	2 / 20
	Anthracene	ND - 1.2	1 / 20
	Antimony	ND	0 / 8
	Aroclor 1248	ND - 1.1	2 / 20
	Aroclor 1254	ND - 1.5	1 / 20
	Aroclor 1260	ND - 0.086	1 / 20
	Arsenic	1 - 2.5	20 / 20
	Barium	59.9 - 204	20 / 20
	Benzo(a)anthracene	ND - 0.082	5 / 20
	Benzo(a)pyrene	ND - 0.065	6 / 20
	Benzo(b)fluoranthene	ND - 0.095	7 / 20
	Benzo(g,h,i)perylene	ND - 0.071	4 / 20
	Benzo(k)fluoranthene	ND - 0.04	6 / 20
	Bis(2-ethylhexyl)phthalate	ND - 0.47	1 / 20
	Cadmium	ND	0 / 20
	Carbazole	ND - 0.84	1 / 20
	Chlorpropham	ND - 0.27	1 / 20
	Chromium	7.6 - 23.8	20 / 20
	Chrysene	ND - 0.11	6 / 20
	Copper	14.7 - 27.2	20 / 20
	Dibenzo(a,h)anthracene	ND - 0.021	4 / 20
	Dibenzofuran	ND - 0.59	1 / 20
	Diethylphthalate	ND - 0.01	1 / 20
	Fluoranthene	ND - 0.18	9 / 20
	Fluorene	ND - 0.011	2 / 20
	Indeno(1,2,3-cd)pyrene	ND - 0.068	4 / 20
	Lead	3 - 26.4	20 / 20
	Mercury	ND	0 / 20
	Naphthalene	ND - 2.6	1 / 20
	Nickel	11.6 - 20.1	20 / 20
	Pentachlorophenol	ND - 0.56	1 / 20
	Phenanthrene	ND - 4.3	2 / 20
	Pyrene	ND - 0.18	11 / 20
	Silver	ND	0 / 8
	Toluene	ND - 0.013	2 / 20
	Total carcinogenic HPAHs	ND - 0.552	10 / 20
	Total Xylenes	ND - 0.006	1 / 20
	Zinc	33.9 - 116	20 / 20

Table 2
Summary of Laboratory Results
Shallow Ground Water
Operable Unit B

Concentrations expressed in PPM.

Station	Analyte	Concentration Range	Frequency of Detection
HCMW-1			
	antimony, total	0.0635	1 / 1
	barium, total	1.11	1 / 1
	chromium, total	0.0829	1 / 1
	copper, total	0.0371	1 / 1
	lead, total	0.0377	1 / 1
	mercury, total	0.00025	1 / 1
	nickel, total	0.0858	1 / 1
	zinc, total	0.305	1 / 1
MW-03A			
	1,1,1-trichloroethane	ND - 0.0152	6 / 7
	1,1-dichloroethene	ND - 0.0007	5 / 7
	arsenic, dissolved	ND - 0.0041	1 / 6
	arsenic, total	ND - 0.0032	1 / 5
	barium, dissolved	0.02 - 0.0324	6 / 6
	barium, total	0.017 - 0.04	5 / 5
	chloroform	ND - 0.00031	2 / 7
	chromium, dissolved	ND - 0.275	2 / 4
	chromium, total	ND - 0.286	3 / 4
	chrysene	ND - 0.00001	2 / 3
	copper, total	ND - 0.0069	1 / 4
	fluorene	ND - 0.00002	1 / 3
	lead, total	ND - 0.0078	2 / 5
	mercury, dissolved	ND - 0.0003	2 / 6
	nickel, dissolved	ND - 0.149	3 / 4
	nickel, total	ND - 0.152	3 / 4
	pyrene	ND - 0.000022	2 / 3
	zinc, dissolved	ND - 0.008	1 / 4
	zinc, total	ND - 0.0389	2 / 4
MW-04A			
	1,1,1-trichloroethane	0.152 - 0.82	8 / 8
	1,1-dichloroethane	ND - 0.001	4 / 8
	1,1-dichloroethene	ND - 0.078	6 / 8
	barium, dissolved	ND - 0.003	5 / 6
	barium, total	0.0357 - 0.0505	4 / 4
	bromacil	0.0023 - 0.0033	4 / 4
	chromium, total	0.0495 - 0.0595	4 / 4
	copper, dissolved	ND - 0.0094	1 / 4
	copper, total	ND - 0.0081	1 / 4
	lead, dissolved	ND - 0.0087	1 / 5
	lead, total	ND - 0.0109	4 / 5
	nickel, total	ND - 0.0271	3 / 4
	zinc, dissolved	ND - 0.0141	1 / 4
	zinc, total	ND - 0.0216	1 / 4

Station	Analyte	Concentration Range	Frequency of Detection
MW-06A			
	antimony, total	ND - 0.0178	1 / 4
	arsenic, total	ND - 0.0048	2 / 4
	barium, dissolved	0.0103 - 0.0111	4 / 4
	barium, total	0.0382 - 0.594	4 / 4
	cadmium, total	ND - 0.0021	1 / 4
	chromium, total	ND - 0.0369	3 / 4
	copper, dissolved	ND - 0.0069	1 / 4
	copper, total	ND - 0.0755	2 / 4
	di-n-butylphthalate	ND - 0.0034	2 / 5
	diuron	0.0016 - 0.0051	5 / 5
	lead, dissolved	ND - 0.0026	1 / 4
	lead, total	ND - 0.0141	3 / 4
	neburon	ND - 0.00079	1 / 5
	nickel, total	ND - 0.0525	2 / 4
	zinc, dissolved	ND - 0.0271	1 / 4
	zinc, total	ND - 0.227	3 / 4
MW-07A			
	1,1,1-trichloroethane	0.002 - 0.006	4 / 4
	antimony, total	ND - 0.0314	1 / 4
	arsenic, total	ND - 0.0047	3 / 4
	barium, dissolved	0.0036 - 0.011	4 / 4
	barium, total	0.0619 - 0.315	4 / 4
	benzo(a)anthracene	ND - 0.000052	1 / 4
	benzo(a)pyrene	ND - 0.000041	1 / 4
	benzo(b)fluoranthene	ND - 0.000028	1 / 4
	benzo(k)fluoranthene	ND - 0.000015	1 / 4
	bromacil	ND - 0.0014	1 / 4
	chromium, total	ND - 0.0248	2 / 4
	chrysene	ND - 0.000044	1 / 4
	copper, total	ND - 0.0434	2 / 4
	di-n-butylphthalate	ND - 0.0018	1 / 4
	dibenzo(a,h)anthracene	ND - 0.000011	1 / 4
	diuron	0.0013 - 0.0023	4 / 4
	fluoranthene	ND - 0.000049	2 / 4
	lead, dissolved	ND - 0.0043	2 / 4
	lead, total	0.0035 - 0.0155	4 / 4
	nickel, total	ND - 0.0288	2 / 4
	pyrene	ND - 0.00013	2 / 4
	silver, dissolved	ND - 0.0032	1 / 4
	zinc, dissolved	ND - 0.0243	1 / 4
	zinc, total	0.0763 - 0.165	4 / 4

ND - not detected.

Table 2
Summary of Laboratory Results
Shallow Ground Water
Operable Unit B

Concentrations expressed in PPM.

Station	Analyte	Concentration Range	Frequency of Detection
MW-08A			
	1,1,1-trichloroethane	0.003 - 0.004	6 / 6
	arsenic, total	ND - 0.0021	1 / 6
	barium, dissolved	0.0082 - 0.0109	6 / 6
	barium, total	0.0105 - 0.0427	6 / 6
	bromacil	ND - 0.0022	1 / 6
	chromium, dissolved	ND - 0.0077	1 / 6
	chromium, total	ND - 0.024	2 / 6
	copper, dissolved	ND - 0.0112	3 / 6
	copper, total	ND - 0.0102	3 / 6
	di-n-butylphthalate	ND - 0.0007	1 / 6
	diuron	ND - 0.00055	1 / 6
	fluorene	ND - 0.000039	2 / 6
	lead, dissolved	ND - 0.0026	1 / 6
	lead, total	ND - 0.0026	2 / 6
	nickel, total	ND - 0.012	2 / 6
	zinc, dissolved	ND - 0.0079	2 / 6
	zinc, total	ND - 0.0244	3 / 6
MW-12AR			
	1,1-dichloroethane	ND - 0.0002	3 / 4
	arsenic, total	ND - 0.0084	3 / 4
	barium, dissolved	0.123 - 0.143	4 / 4
	barium, total	0.173 - 0.472	4 / 4
	chromium, total	ND - 0.0354	2 / 4
	copper, dissolved	ND - 0.0174	2 / 4
	copper, total	ND - 0.0651	2 / 4
	diuron	0.0042 - 0.0064	4 / 4
	lead, dissolved	ND - 0.0021	1 / 4
	lead, total	0.0033 - 0.0302	4 / 4
	nickel, dissolved	ND - 0.0048	1 / 4
	nickel, total	ND - 0.0326	1 / 4
	pentachlorophenol	ND - 0.00095	1 / 3
	pyrene	ND - 0.000027	1 / 4
	silver, dissolved	ND - 0.0061	2 / 4
	silver, total	ND - 0.008	1 / 3
	zinc, dissolved	ND - 0.0262	2 / 4
	zinc, total	0.0704 - 0.161	4 / 4
MW-17A (Background)			
	barium, dissolved	0.0095 - 0.0195	4 / 4
	barium, total	0.0127 - 0.041	4 / 4
	chromium, dissolved	ND - 0.006	1 / 4
	chromium, total	ND - 0.0122	2 / 4
	copper, dissolved	ND - 0.0088	1 / 4
	copper, total	ND - 0.0078	1 / 4
	lead, total	ND - 0.0042	2 / 4
	nickel, total	ND - 0.0054	1 / 4
	zinc, dissolved	ND - 0.0181	1 / 4
	zinc, total	ND - 0.0219	1 / 4

ND - not detected.

Station	Analyte	Concentration Range	Frequency of Detection
MW-18A			
	1,1,1-trichloroethane	0.0003 - 0.0005	4 / 4
	arsenic, total	ND - 0.0029	1 / 4
	barium, dissolved	0.0157 - 0.0376	4 / 4
	barium, total	0.084 - 0.215	4 / 4
	bromacil	ND - 0.0023	2 / 4
	chromium, total	ND - 0.0263	2 / 4
	copper, dissolved	ND - 0.0071	1 / 4
	copper, total	ND - 0.0116	1 / 4
	diuron	ND - 0.005	2 / 4
	fluoranthene	ND - 0.000021	1 / 4
	lead, dissolved	ND - 0.0021	1 / 4
	lead, total	0.0041 - 0.0133	4 / 4
	nickel, total	ND - 0.0228	1 / 4
	silver, total	ND - 0.0066	1 / 4
	zinc, total	0.0215 - 0.0915	4 / 4
MW-27A			
	barium, dissolved	0.0523	1 / 1
	barium, total	0.056	1 / 1
	bromacil	0.0031	1 / 1
	chromium, dissolved	0.0258	1 / 1
	chromium, total	0.024	1 / 1
	nickel, dissolved	0.0143	1 / 1
	nickel, total	0.0149	1 / 1
MW-28A			
	arsenic, total	0.0026	1 / 1
	barium, dissolved	0.0309	1 / 1
	barium, total	0.395	1 / 1
	chromium, total	0.0297	1 / 1
	copper, total	0.0625	1 / 1
	lead, total	0.017	1 / 1
	nickel, total	0.0273	1 / 1
	pyrene	0.000015	1 / 1
	zinc, dissolved	0.0199	1 / 1
	zinc, total	0.121	1 / 1
MW-30A			
	1,1,1-trichloroethane	0.01	1 / 1
	1,1-dichloroethane	0.0005	1 / 1
	1,1-dichloroethene	0.001	1 / 1
	antimony, total	0.0256	1 / 1
	arsenic, total	0.0021	1 / 1
	barium, dissolved	0.0275	1 / 1
	barium, total	0.304	1 / 1
	chromium, total	0.0226	1 / 1
	copper, total	0.0576	1 / 1
	lead, total	0.0151	1 / 1
	nickel, total	0.0214	1 / 1
	zinc, total	0.103	1 / 1

Table 3
Summary of Laboratory Results
Deep Ground Water
Operable Unit B

Concentrations expressed in PPM.

Station	Analyte	Concentration Range	Frequency of Detection
MW-01			
	1,1,1-trichloroethane	ND - 0.008	5 / 7
	1,1-dichloroethene	ND - 0.001	4 / 7
	antimony, total	ND - 0.0176	1 / 4
	arsenic, dissolved	ND - 0.0024	2 / 5
	arsenic, total	ND - 0.0026	1 / 5
	barium, dissolved	0.0048 - 0.0122	6 / 6
	barium, total	0.0091 - 0.0124	4 / 4
	benzo(b)fluoranthene	ND - 0.000011	1 / 4
	bromacil	ND - 0.0016	2 / 4
	chloroform	ND - 0.005	2 / 7
	chromium, total	ND - 0.0464	2 / 4
	diuron	0.00057 - 0.00099	4 / 4
	lead, total	ND - 0.0074	1 / 5
	nickel, dissolved	ND - 0.0048	1 / 4
	nickel, total	ND - 0.0936	2 / 4
	zinc, dissolved	ND - 0.0064	1 / 4
	zinc, total	ND - 0.0054	1 / 4
MW-02			
	arsenic, dissolved	ND - 0.0071	2 / 5
	arsenic, total	ND - 0.0071	3 / 5
	barium, dissolved	0.0084 - 0.0156	6 / 6
	barium, total	0.0103 - 0.02	5 / 5
	benzo(a)anthracene	ND - 0.000021	1 / 4
	benzo(a)pyrene	ND - 0.000022	1 / 4
	benzo(b)fluoranthene	ND - 0.000013	1 / 4
	chromium, total	0.0254 - 0.113	4 / 4
	chrysene	ND - 0.00002	1 / 4
	copper, dissolved	ND - 0.0067	1 / 4
	fluorene	ND - 0.000032	1 / 4
	lead, dissolved	ND - 0.0037	1 / 4
	lead, total	ND - 0.0081	3 / 5
	nickel, dissolved	ND - 0.0095	2 / 4
	nickel, total	ND - 0.0545	3 / 4
	pyrene	ND - 0.000027	1 / 4
	zinc, dissolved	ND - 0.0041	1 / 4
	zinc, total	ND - 0.0035	1 / 4
MW-03BR			
	1,1,1-trichloroethane	0.001 - 0.003	4 / 4
	barium, dissolved	0.0231 - 0.0241	4 / 4
	barium, total	0.0236 - 0.0371	4 / 4
	bromacil	ND - 0.0024	1 / 4
	chloroform	ND - 0.0001	1 / 6
	chromium, total	ND - 0.01	2 / 4
	copper, total	ND - 0.0073	1 / 4
	zinc, total	ND - 0.0034	1 / 4

Station	Analyte	Concentration Range	Frequency of Detection
MW-04B			
	1,1,1-trichloroethane	ND - 0.0061	3 / 8
	barium, dissolved	0.01 - 0.0157	6 / 6
	barium, total	0.0177 - 0.268	5 / 5
	chloroform	ND - 0.032	1 / 8
	chromium, total	0.0082 - 1.37	4 / 4
	copper, total	ND - 0.0436	3 / 4
	lead, total	ND - 0.0084	4 / 5
	nickel, dissolved	ND - 0.0114	1 / 4
	nickel, total	0.0107 - 0.676	4 / 4
	zinc, total	ND - 0.102	2 / 4
MW-05			
	1,1,1-trichloroethane	ND - 0.042	6 / 7
	1,1-dichloroethane	ND - 0.0002	2 / 7
	1,1-dichloroethene	ND - 0.011	5 / 7
	arsenic, dissolved	ND - 0.0024	1 / 6
	arsenic, total	ND - 0.0029	2 / 5
	barium, dissolved	ND - 0.02	5 / 6
	barium, total	0.01 - 0.0151	5 / 5
	chloroform	ND - 0.031	4 / 7
	chromium, total	ND - 0.101	3 / 4
	lead, dissolved	ND - 0.0026	1 / 6
	lead, total	ND - 0.0094	1 / 5
	nickel, dissolved	ND - 0.0052	1 / 4
	nickel, total	ND - 0.0585	2 / 4
MW-09B			
	1,1,1-trichloroethane	0.003 - 0.006	4 / 4
	1,1-dichloroethene	ND - 0.0005	2 / 4
	arsenic, dissolved	ND - 0.0029	1 / 3
	arsenic, total	ND - 0.0022	1 / 4
	barium, dissolved	0.0136 - 0.0225	3 / 3
	barium, total	0.0226 - 0.0986	4 / 4
	chromium, total	0.0207 - 0.884	4 / 4
	copper, total	ND - 0.0359	1 / 4
	fluoranthene	ND - 0.000016	1 / 4
	lead, total	ND - 0.0047	2 / 4
	nickel, dissolved	ND - 0.0121	1 / 3
	nickel, total	ND - 0.425	2 / 4
	zinc, total	ND - 0.058	2 / 4

ND - not detected.

Table 3
Summary of Laboratory Results
Deep Ground Water
Operable Unit B

Concentrations expressed in PPM.

Station	Analyte	Concentration Range	Frequency of Detection
MW-10B			
	1,1,1-trichloroethane	0.005 - 0.007	4 / 4
	1,1-dichloroethene	0.0006 - 0.001	4 / 4
	barium, dissolved	0.0197 - 0.0316	4 / 4
	barium, total	0.0302 - 0.0645	4 / 4
	carbon tetrachloride	0.001 - 0.001	4 / 4
	chloroform	ND - 0.001	1 / 4
	chromium, total	0.0464 - 0.346	4 / 4
	copper, total	ND - 0.007	1 / 4
	fluoranthene	ND - 0.00008	1 / 4
	isophorone	ND - 0.0007	1 / 4
	lead, total	ND - 0.0036	3 / 4
	nickel, dissolved	ND - 0.0358	3 / 4
	nickel, total	0.0505 - 0.173	4 / 4
	pyrene	ND - 0.000016	1 / 4
	silver, total	ND - 0.006	1 / 4
	zinc, total	ND - 0.0186	1 / 4
MW-11B (Background)			
	arsenic, total	ND - 0.0046	1 / 4
	barium, dissolved	0.0141 - 0.0192	4 / 4
	barium, total	0.0787 - 0.217	4 / 4
	chromium, total	0.167 - 0.252	4 / 4
	copper, total	ND - 0.0286	2 / 4
	lead, dissolved	ND - 0.0032	1 / 4
	lead, total	0.002 - 0.0119	4 / 4
	nickel, dissolved	ND - 0.0208	2 / 4
	nickel, total	0.085 - 0.135	4 / 4
	zinc, dissolved	ND - 0.0031	1 / 4
	zinc, total	ND - 0.0556	3 / 4
MW-13B			
	1,1,1-trichloroethane	**0.021 - 0.042**	**5 / 5**
	1,1-dichloroethane	ND - 0.0002	3 / 5
	1,1-dichloroethene	**0.009 - 0.014**	**5 / 5**
	barium, dissolved	0.0093 - 0.0117	5 / 5
	barium, total	0.0093 - 0.018	5 / 5
	cadmium, dissolved	ND - 0.0019	1 / 5
	chloroform	**ND - 0.011**	**1 / 5**
	chromium, total	0.0085 - 0.0136	5 / 5
	copper, dissolved	ND - 0.0064	1 / 5
	copper, total	ND - 0.0068	1 / 5
	lead, dissolved	ND - 0.0022	2 / 5
	lead, total	ND - 0.0021	1 / 5
	nickel, dissolved	ND - 0.0043	1 / 5
	nickel, total	ND - 0.0107	3 / 5

Station	Analyte	Concentration Range	Frequency of Detection
MW-14B			
	1,1,1-trichloroethane	0.001 - 0.003	5 / 5
	1,1-dichloroethene	0.0005 - 0.009	5 / 5
	barium, dissolved	0.0137 - 0.0187	5 / 5
	barium, total	0.0139 - 0.0164	5 / 5
	chromium, total	ND - 0.0102	4 / 5
	copper, total	ND - 0.0063	1 / 5
	nickel, total	ND - 0.0051	1 / 5
	zinc, dissolved	ND - 0.0071	1 / 5
	zinc, total	ND - 0.0071	1 / 5
MW-16B			
	1,1,1-trichloroethane	0.011 - 0.018	4 / 4
	1,1-dichloroethane	ND - 0.0001	2 / 4
	1,1-dichloroethene	0.003 - 0.005	4 / 4
	arsenic, total	ND - 0.0025	1 / 4
	barium, dissolved	ND - 0.0091	3 / 4
	barium, total	ND - 0.01	3 / 4
	bromacil	ND - 0.0011	1 / 4
	chloroform	ND - 0.007	1 / 4
	chromium, total	ND - 0.0095	1 / 4
	nickel, total	ND - 0.004	1 / 4
	zinc, dissolved	ND - 0.0509	1 / 4
	zinc, total	ND - 0.0042	1 / 4
MW-17B (Background)			
	barium, dissolved	0.0086 - 0.0237	4 / 4
	barium, total	0.01 - 0.0222	4 / 4
	chromium, total	ND - 0.0108	2 / 4
	lead, dissolved	ND - 0.0047	1 / 4
	nickel, dissolved	ND - 0.0048	1 / 4
	nickel, total	ND - 0.0054	2 / 4
	zinc, dissolved	ND - 0.0066	1 / 4
	zinc, total	ND - 0.0043	1 / 4
MW-19B			
	1,1,1-trichloroethane	0.001 - 0.006	4 / 4
	1,1-dichloroethene	ND - 0.001	3 / 4
	barium, dissolved	0.0074 - 0.0096	4 / 4
	barium, total	0.0073 - 0.0091	4 / 4
	chloroform	ND - 0.001	1 / 4
	lead, total	ND - 0.0036	1 / 4
	zinc, dissolved	ND - 0.0098	1 / 4

ND - not detected.

Table 3
Summary of Laboratory Results
Deep Ground Water
Operable Unit B

Concentrations expressed in PPM.

Station	Analyte	Concentration Range	Frequency of Detection
MW-20BR			
	1,1,1-trichloroethane	0.0005 - 0.001	4 / 4
	1,1-dichloroethene	ND - 0.0003	2 / 4
	barium, dissolved	0.0077 - 0.0109	4 / 4
	barium, total	0.0072 - 0.0145	4 / 4
	chloroform	ND - 0.0002	1 / 4
	chromium, dissolved	ND - 0.0066	1 / 4
	chromium, total	ND - 0.0114	3 / 4
	lead, total	ND - 0.0191	2 / 4
	nickel, total	ND - 0.0071	1 / 4
MW-22C			
	1,1,1-trichloroethane	0.004	1 / 1
	1,1-dichloroethene	0.0006	1 / 1
	barium, dissolved	0.0132	1 / 1
	barium, total	0.0193	1 / 1
	chloroform	0.002	1 / 1
	chromium, total	0.435	1 / 1
	copper, total	0.0251	1 / 1
	nickel, total	0.24	1 / 1
MW-24B			
	1,1,1-trichloroethane	0.0003	1 / 1
	antimony, total	0.0388	1 / 1
	barium, dissolved	0.0103	1 / 1
	barium, total	0.0484	1 / 1
	chromium	4.38	1 / 1
	copper, total	0.096	1 / 1
	lead, total	0.003	1 / 1
	nickel, dissolved	0.177	1 / 1
	nickel, total	2.16	1 / 1
	zinc, total	0.0089	1 / 1
MW-25B			
	1,1,1-trichloroethane	0.0003	1 / 1
	barium, total	0.0082	1 / 1
	chloroform	0.0002	1 / 1
	chromium, total	0.0068	1 / 1
MW-26C			
	barium, total	0.005	1 / 1
	chromium, total	1.72	1 / 1
	copper, dissolved	0.0064	1 / 1
	copper, total	0.0526	1 / 1
	nickel, total	0.901	1 / 1

ND - not detected.

Station	Analyte	Concentration Range	Frequency of Detection
MW-28BR			
	barium, dissolved	0.0135	1 / 1
	barium, total	0.13	1 / 1
	chromium, total	0.441	1 / 1
	copper, total	0.0378	1 / 1
	lead, total	0.0036	1 / 1
	nickel, dissolved	0.0038	1 / 1
	nickel, total	0.246	1 / 1
	zinc, total	0.0145	1 / 1
MW-29B			
	1,1,1-trichloroethane	0.0001	1 / 1
	barium, dissolved	0.0171	1 / 1
	barium, total	0.0211	1 / 1
	chromium, total	0.0065	1 / 1
	nickel, dissolved	0.0038	1 / 1
	nickel, total	0.0044	1 / 1
MW-31C			
	1,1,1-trichloroethane	0.005	1 / 1
	1,1-dichloroethene	0.0008	1 / 1
	barium, dissolved	0.0402	1 / 1
	barium, total	0.0813	1 / 1
	chloroform	0.0003	1 / 1
	chromium, total	0.397	1 / 1
	lead, dissolved	0.0024	1 / 1
	lead, total	0.0156	1 / 1
	nickel, dissolved	0.0198	1 / 1
	nickel, total	0.199	1 / 1
	zinc, total	0.0633	1 / 1
DIT			
	1,1,1-trichloroethane	ND - 0.038	8 / 10
	1,1-dichloroethene	ND - 0.0118	8 / 10
	barium, dissolved	ND - 0.0088	4 / 6
	barium, total	ND - 0.0106	4 / 5
	benzo(a)anthracene	ND - 0.00072	1 / 4
	benzo(a)pyrene	ND - 0.00048	1 / 4
	benzo(b)fluoranthene	ND - 0.00038	1 / 4
	benzo(g,h,i)perylene	ND - 0.00029	1 / 4
	benzo(k)fluoranthene	ND - 0.00014	1 / 4
	chloroform	ND - 0.011	2 / 10
	chrysene	ND - 0.00057	1 / 4
	dibenzo(a,h)anthracene	ND - 0.000069	1 / 4
	fluoranthene	ND - 0.0011	1 / 4
	indeno(1,2,3-cd)pyrene	ND - 0.00015	1 / 4
	lead, total	ND - 0.0129	2 / 5
	pyrene	ND - 0.0017	1 / 4
	zinc, total	ND - 0.0393	1 / 4

Table 4
Summary of Laboratory Results
Surface Water
Operable Unit B

Concentrations expressed in mg/l.

Station	Analyte	Concentration Range	Frequency of Detection
Cold Creek			
	1,1,1-Trichloroethane	ND - 0.085	18 / 41
	1,1-Dichloroethene	ND - 0.008	8 / 41
	1,1-Dichloroethane	ND - 0.002	10 / 41
	2,4-D	ND - 0.013	9 / 19
	Antimony	ND	0 / 51
	Arsenic	ND - 0.0026	2 / 51
	Barium	ND - 0.0765	43 / 51
	Benzo(a)anthracene	ND - 0.000098	5 / 35
	Benzo(a)pyrene	ND - 0.000063	5 / 35
	Benzo(b)fluoranthene	ND - 0.00025	9 / 35
	Benzo(g,h,i)perylene	ND - 0.000067	3 / 35
	Benzo(k)fluoranthene	ND - 0.000096	5 / 35
	Bromacil	ND - 0.0011	4 / 19
	Cadmium	ND - 0.0016	5 / 51
	Carbon tetrachloride	ND - 0.01	2 / 21
	Chromium	ND - 0.0112	1 / 51
	Chrysene	ND - 0.000076	9 / 35
	Copper	ND - 0.0422	15 / 35
	Dibenzo(a,h)anthracene	ND - 0.000017	1 / 35
	Dicamba	ND - 0.0046	3 / 19
	Diuron	ND - 0.055	10 / 19
	Fluoranthene	ND - 0.0046	13 / 35
	Fluorene	ND - 0.00037	3 / 35
	Indeno(1,2,3-cd)pyrene	ND - 0.000081	5 / 35
	Lead	ND - 0.0116	8 / 51
	Mercury	ND	0 / 51
	Methylene chloride	ND - 0.011	1 / 41
	Nickel	ND	0 / 51
	Propham	ND - 0.0013	1 / 19
	Pyrene	ND - 0.00075	14 / 35
	Silver	ND - 0.00028	5 / 51
	Simazine	ND - 0.0016	3 / 19
	total 1,2-Dichloroethene	ND - 0.0002	1 / 41
	Total carcinogenic HPAH	ND - 0.000634	10 / 35
	Zinc	ND - 0.142	32 / 51

Station	Analyte	Concentration Range	Frequency of Detection
Burnt Bridge Creek			
	2,4-D	ND - 0.0031	1 / 13
	Antimony	ND	0 / 12
	Arsenic	ND - 0.002	1 / 12
	Barium	ND	0 / 12
	Benzo(a)anthracene	ND - 0.000025	3 / 13
	Benzo(a)pyrene	ND - 0.00003	3 / 13
	Benzo(b)fluoranthene	ND - 0.000067	3 / 13
	Benzo(g,h,i)perylene	ND - 0.000032	1 / 13
	Benzo(k)fluoranthene	ND - 0.000025	2 / 13
	Bis(2-ethylhexyl)phthalate	ND - 0.012	1 / 12
	Cadmium	ND - 0.0014	7 / 12
	Chloroform	ND - 0.0002	1 / 12
	Chromium	ND - 0.208	3 / 12
	Chrysene	ND - 0.00006	6 / 13
	Copper	ND - 0.0149	9 / 12
	Dibenzo(a,h)anthracene	ND - 0.000016	1 / 13
	Dicamba	ND - 0.00097	1 / 13
	Diuron	ND - 0.0023	4 / 13
	Fluoranthene	ND - 0.00011	7 / 13
	Indeno(1,2,3-cd)pyrene	ND - 0.000035	2 / 13
	Lead	ND - 0.012	4 / 12
	Mercury	ND	0 / 12
	Nickel	ND - 0.108	1 / 12
	Prometon	ND - 0.0081	2 / 13
	Pyrene	ND - 0.00013	8 / 13
	Silver	ND	0 / 12
	Simazine	ND - 0.0017	2 / 13
	Total HPAH	ND - 0.00041	8 / 13
	Zinc	ND - 0.0843	3 / 12

ND - not detected.

Table 5
Summary of Laboratory Results
Sediment
Operable Unit B

Concentrations expressed in mg/kg.

Station	Analyte	Concentration Range	Frequency of Detection
Cold Creek			
	2-Butanone	ND - 0.036	2 / 29
	Acenaphthene	ND - 0.048	1 / 29
	Anthracene	ND - 0.12	2 / 29
	Antimony	ND - 10.8	20 / 30
	Arsenic	ND - 6.9	29 / 30
	Barium	58.1 - 166	30 / 30
	Benzo(a)anthracene	ND - 1.1	16 / 30
	Benzo(a)pyrene	ND - 0.94	18 / 30
	Benzo(b)fluoranthene	ND - 0.77	13 / 30
	Benzo(g,h,i)perylene	ND - 0.27	13 / 30
	Benzo(k)fluoranthene	ND - 0.4	15 / 30
	Bis(2-ethylhexyl)phthalate	ND - 0.38	3 / 29
	Butylbenzylphthalate	ND - 0.028	1 / 29
	Cadmium	ND - 4.1	29 / 30
	Carbazole	ND - 0.16	4 / 29
	Chromium	5.5 - 22.9	30 / 30
	Chrysene	ND - 1.2	16 / 30
	Copper	ND - 47.1	12 / 30
	Di-n-butylphthalate	ND - 0.041	3 / 29
	Dibenzo(a,h)anthracene	ND - 0.094	8 / 30
	Dibenzofuran	ND - 0.033	1 / 29
	Fluoranthene	ND - 8	18 / 30
	Fluorene	ND - 0.59	6 / 30
	Indeno(1,2,3-cd)pyrene	ND - 0.46	13 / 30
	Lead	2.9 - 12.2	30 / 30
	Mercury	ND	0 / 30
	Nickel	6.9 - 14.8	30 / 30
	Phenanthrene	ND - 0.92	11 / 29
	Pyrene	ND - 7.2	18 / 30
	Silver	ND	0 / 30
	Zinc	59.8 - 139	30 / 30

Station	Analyte	Concentration Range	Frequency of Detection
Burnt Bridge Creek			
	Acetone	ND - 0.028	5 / 6
	Antimony	ND	0 / 6
	Arsenic	0.77 - 58.1	6 / 6
	Barium	66.4 - 96.7	6 / 6
	Benzo(a)anthracene	ND - 0.034	5 / 6
	Benzo(a)pyrene	ND - 0.05	5 / 6
	Benzo(b)fluoranthene	ND - 0.067	5 / 6
	Benzo(g,h,i)perylene	ND - 0.039	5 / 6
	Benzo(k)fluoranthene	ND - 0.024	5 / 6
	Butylbenzylphthalate	ND - 0.055	1 / 6
	Cadmium	ND - 0.92	5 / 6
	Chlorpropham	ND - 0.24	1 / 6
	Chromium	8.3 - 12.6	6 / 6
	Chrysene	ND - 0.036	5 / 6
	Copper	9.2 - 16.7	6 / 6
	Di-n-butylphthalate	ND - 1.2	1 / 6
	Dibenzo(a,h)anthracene	ND - 0.007	4 / 6
	Diethylphthalate	ND - 0.5	1 / 6
	Fluoranthene	ND - 0.11	5 / 6
	Indeno(1,2,3-cd)pyrene	ND - 0.037	4 / 6
	Lead	6 - 15.1	6 / 6
	Mercury	ND	0 / 6
	Nickel	9.4 - 20	6 / 6
	Pyrene	ND - 0.11	5 / 6
	Silver	ND	0 / 6
	Total HPAH	ND - 0.512	5 / 6
	Zinc	76.7 - 92.7	6 / 6

ND - not detected.

TABLE 6
OUB SOIL AND GROUNDWATER CLEANUP LEVELS

Compounds of Concern	RAO Source	Soil Cleanup Level (ppm)	Groundwater Cleanup Level (ppm)
Total HPAHs	MTCA Method A residential	1	N/A
Total PCBs	MTCA Method A residential	1	N/A
Metals: Lead Arsenic Antimony Copper Zinc	MTCA Method A residential Method A residential Method B residential Method B residential Method B residential	250 20 32 2960 16,000	N/A N/A N/A N/A N/A

Compounds of Concern	RAO Source	Groundwater Clean Up Level (ppm)
Volatile Organic TCA DCE Chloroform	EPA Maximum Contaminant Level (for drinking water)	 0.2 0.007 0.1

6.4.1 Subsurface Soil

6.4.1.1 Fog Chamber Dump

Trench Area 1: Solid waste debris was observed in the Fog Chamber Dump Trench Area 1 from 1.5 to 12 feet below ground surface (bgs) in the general disposal area and as deep as 22.5 feet bgs in an isolated area. Types of waste observed included: 5-gallon buckets, concrete rubble, paint cans, scrap metal, lead batteries, wood debris, paper, plastic and burned material. Approximately 1.5 feet of clean fill covered with vegetation overlies the disposal area and access is restricted by fencing. Compounds of concern found in Trench Area 1 soils include antimony, arsenic, copper, lead, HPAHs, and PCBs. The highest levels of chemical contamination generally corresponded to observed areas of debris (PCBs concentrations). Figure 3 shows the concentrations and distributions of contaminants and the estimated area of contamination in this waste unit.

Trench Area 2: The solid waste debris was observed in the Fog Chamber Dump Trench Area 2 between 1.5 feet to 10 feet bgs and generally included non-process waste such as car tie rods, wires, cables, chain links, and concrete debris. Compounds of concern found in Trench Area 2 soils that exceed state cleanup levels included antimony, arsenic, copper, lead, zinc, and HPAHs. The compounds of concern found in Trench Area 2 subsurface soils were found between 1.5 feet and 3.5 feet bgs. Figure 4 shows the concentrations and distributions of contaminants and the estimated area of contamination in this waste unit.

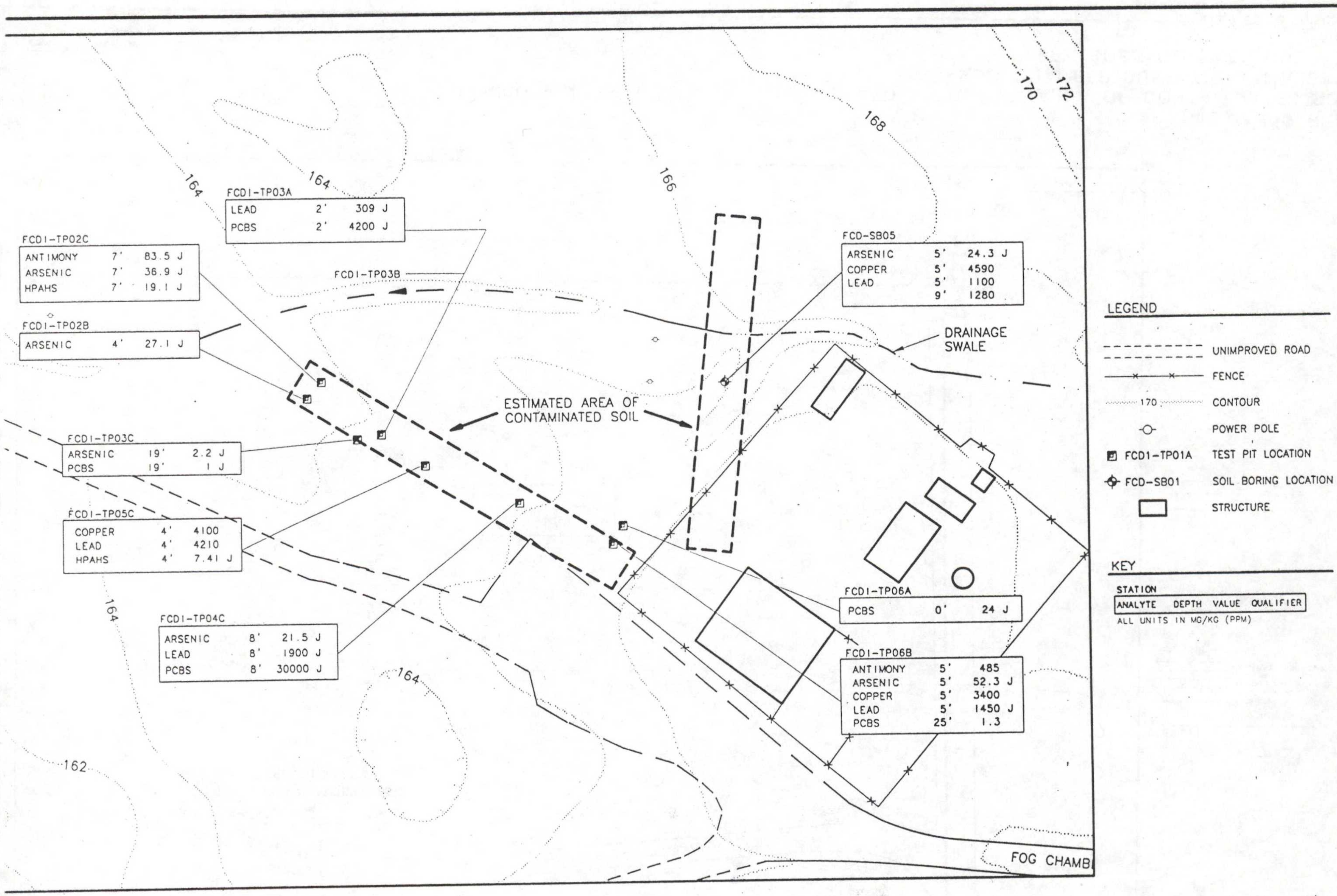
6.4.1.2 Cold Creek Fill Area

Compounds of concern identified in the Cold Creek Fill Area include arsenic and PCBs and were found between 0 and 10 feet bgs.

6.4.2 Groundwater

Groundwater wells were installed in the shallow perched water table and the deep aquifer and have been monitored on a quarterly basis since the fall of 1991. The quarterly groundwater analytical results conducted during the OUA and OUB RIs, are summarized in Table 3. Monitoring well locations are shown in Figure 2.

Naturally occurring metals were found in both the shallow water table and the deep aquifer hydraulically upgradient and downgradient monitoring wells, but the concentrations of these metals are generally below EPA Maximum Contaminant Levels (MCLs) and MTCA groundwater cleanup levels where available. Where MCLs were not available, the MTCA groundwater cleanup levels were used to evaluate contaminant concentrations. Since groundwater samples from wells located hydraulically upgradient of the Site contained similar levels of metals to the downgradient wells, it is concluded that the Site has not contributed metals contamination to the shallow perched groundwater or deep groundwater.



N

0 30 60 90

SCALE IN FEET

FIGURE 3
DISTRIBUTION OF HPAHS, PCBS, AND METALS AND ESTIMATED AREA OF CONTAMINATION
FOG CHAMBER DUMP TRENCH AREA 1
BPA ROSS COMPLEX OUB ROD

Dames & Moore

Job No. 06737-012-008

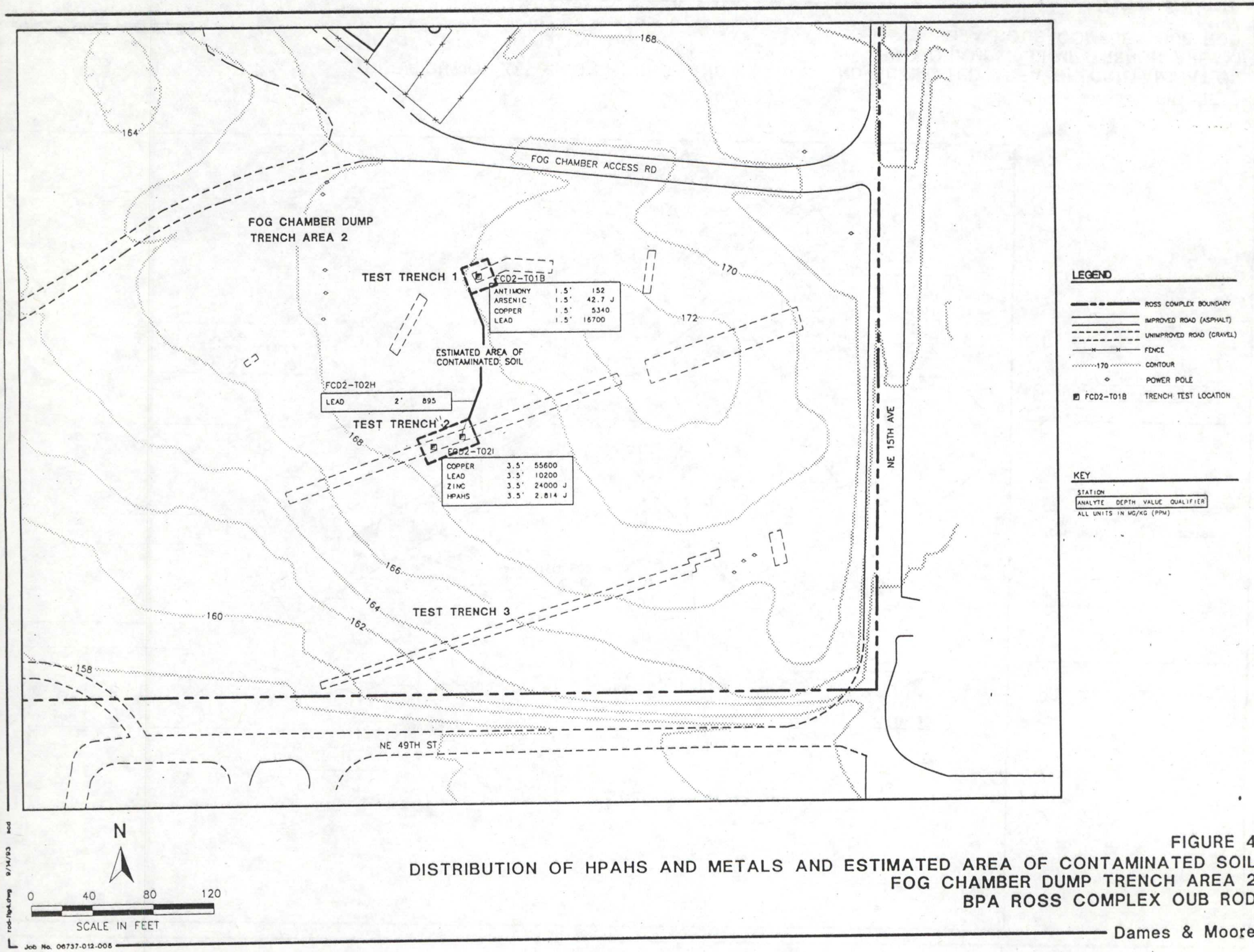


FIGURE 4
DISTRIBUTION OF HPAHS AND METALS AND ESTIMATED AREA OF CONTAMINATED SOIL
FOG CHAMBER DUMP TRENCH AREA 2
BPA ROSS COMPLEX OUB ROD

Dames & Moore

Chlorinated volatile organic compounds, 1,1,1-trichloroethane (TCA), 1,1,-dichloroethene (DCE), and 1,1-dichloroethane (DCA) were the only volatile organic compounds found consistently over time at low concentrations, below the MCLs, in three to six shallow monitoring wells. The OUB groundwater cleanup levels are shown in Table 6.

Only TCA and DCE concentrations found in one shallow well, MW-4A, over time were slightly above the MCLs for these compounds which are 0.2 parts per million (ppm) and 0.007 ppm, respectively. The average TCA concentrations over 8 rounds of sampling was 0.26 ppm. Low levels of bromacil and diuron have been found consistently in isolated areas in the shallow water table (MW-6A, MW-7A, MW-18A) but are below available MTCA regulatory levels (diuron, 0.032 ppm).

Low concentrations of TCA and DCA were detected consistently in up to eight deep monitoring wells in the western portion of the Site. The concentrations found were well below the EPA MCLs for these compounds. DCE was detected at low concentrations in six deep wells and only one deep well, MW-13B, contained DCE concentrations slightly above the MCL (0.007 ppm). The average DCE concentrations over 8 rounds of sampling was 0.011 ppm.

Individual HPAHs, di-n-butylphthalate, chloroform (shallow wells), pentachlorophenol, neburon, and isophorone were also detected inconsistently over time during 8 quarters of monitoring in the shallow perched water table and/or the deep aquifer. These compound concentrations were below MCLs (ranging from 0.0001 ppm to 0.001 ppm) and were found either in one quarterly round or in two nonconsecutive rounds and are therefore considered to be anomalous.

6.4.3 Cold Creek Surface Water and Sediment

Surface water and sediment quality was monitored over time in Cold Creek, at a location upstream and upgradient (of the Site) and at locations downstream of the Site to evaluate the potential contribution of contaminants from the Site. The surface water and sediment sampling locations are shown on Figures 5 and 6, and the laboratory analytical results are summarized on Tables 4 and 5.

Metal concentrations detected in downstream surface water samples were similar to the upstream metal concentrations. TCA, DCA, DCE, HPAHs, and herbicides were found inconsistently overtime in the upstream sample locations as well as the downstream monitoring locations. The results suggest that one or more upgradient off-site sources may be contributing contaminants to the creek.

Stormwater runoff samples collected on-site and near Interstate 5 contained the same types of contaminants found in the creek, but at higher concentrations. This indicates that storm runoff from the Site as well as from off-site road surfaces contributes organic and inorganic compounds to the creek.

Low concentrations of TCA, DCE, DCA, and bromacil were found in seeps to Cold Creek, which is representative of and consistent with the characterization of the shallow perched groundwater table.

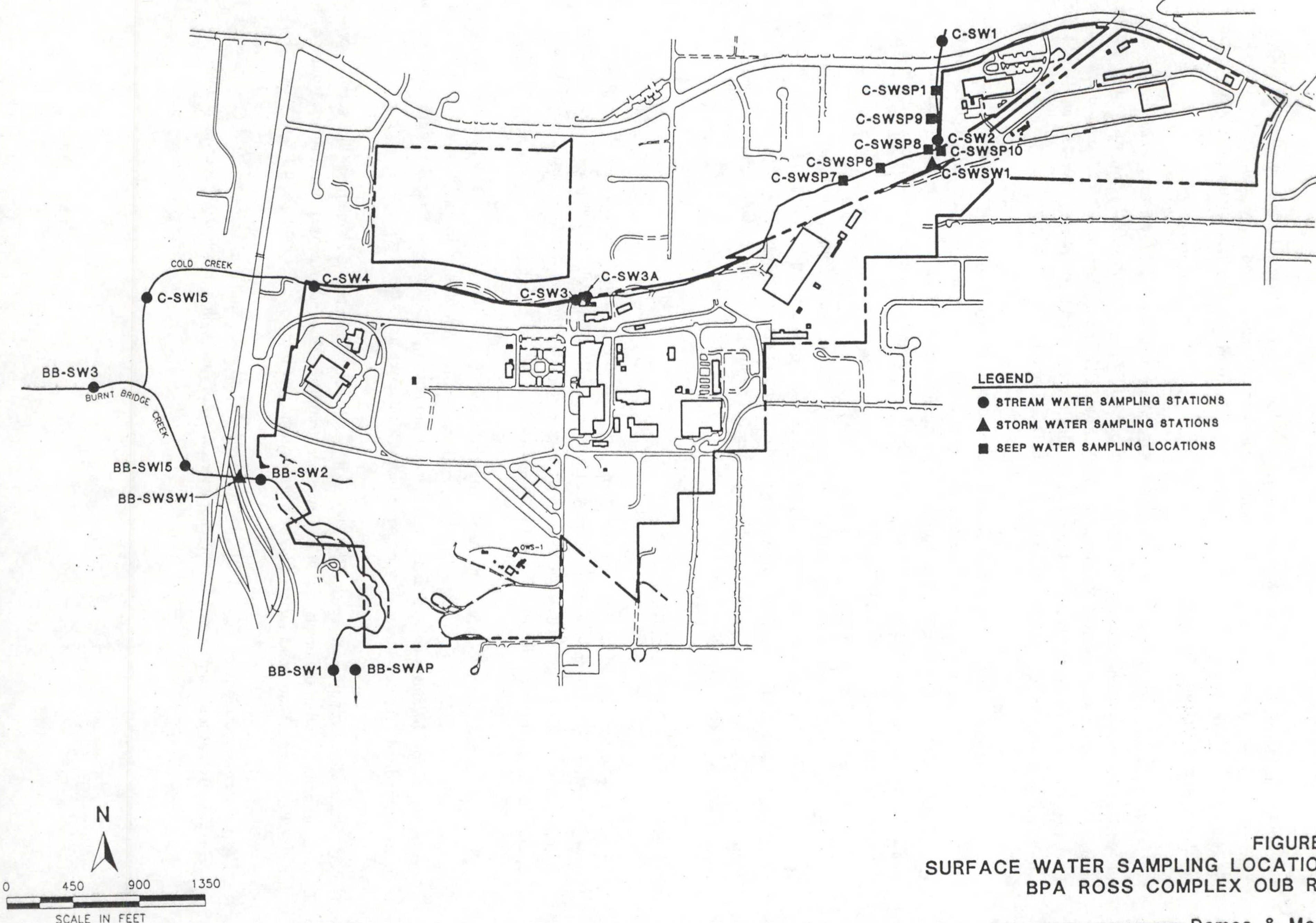


FIGURE 5
SURFACE WATER SAMPLING LOCATIONS
BPA ROSS COMPLEX OUB ROD

Dames & Moore

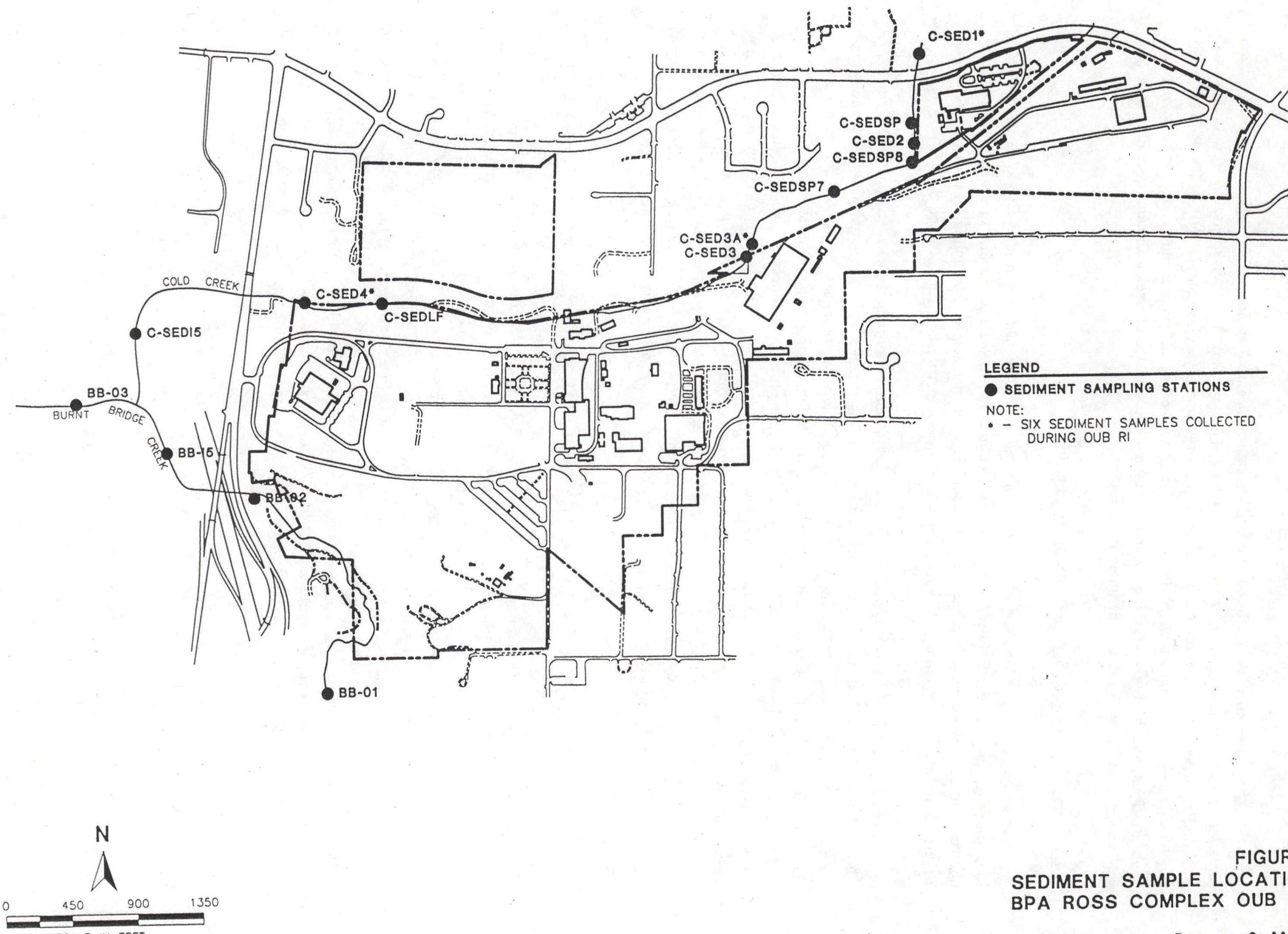


FIGURE 6
SEDIMENT SAMPLE LOCATIONS
BPA ROSS COMPLEX OUB ROD

Dames & Moore

Job No. 06737-012-005

Cold Creek sediments were found to contain metals concentrations increasing slightly in a downstream direction from the Site, suggesting inorganic contaminant contributions from surface runoff from the Site and surrounding areas in the watershed. The results of the organic analyses indicate that HPAH levels in the creek sediments increase in a downstream direction adjacent to the Site at levels significantly above background concentrations, which suggests that these compounds have accumulated in creek sediments over time from Site sources or from the railroad that parallels the creek.

6.4.4 Burnt Bridge Creek Surface Water and Sediment

Surface water and sediment quality was monitored over time in Burnt Bridge Creek, at an upstream location (upgradient of the Site) at the Site, and at locations downstream of the Site to evaluate the potential contribution of contaminants from the Site. The surface water and sediment sampling locations are shown on Figures 5 and 6, and the laboratory analytical results are summarized on Tables 4 and 5.

Burnt Bridge Creek was identified as one of the major carriers of pollutants to Vancouver Lake in 1977. The pollutants identified in the lake include excessive organic and inorganic nutrient loading and bacteriological pollution. The main sources identified were non-point source runoff and sewage from throughout the basin. The RI results of surface water and sediment monitoring in Burnt Bridge Creek indicate that surface water and sediment quality hydraulically upgradient contained organic and inorganic compound concentrations equal to or higher than the downstream locations. Since the downstream samples are representative of potential contaminant contribution from the Site and the results indicated that contaminant concentrations equal or are less than the upstream concentrations, the results indicate that the Site is not significantly contributing to the contamination present in Burnt Bridge Creek. These results support the area wide findings that Burnt Bridge Creek is subject to a wide array of point and non-point sources.

7.0 SUMMARY OF SITE RISKS

CERCLA response actions for OUB at the BPA Ross Complex site as described in this Record of Decision are intended to protect human health and the environment from current and potential future exposure to hazardous substances in soil, groundwater, surface water, and sediment at the Site. To assess these risks, human health and ecological risk assessments were conducted as part of the remedial investigation to characterize the magnitude of risks associated with exposure to contaminated surface soils and to prioritize areas within OUB for remedial action. The human health baseline risk assessment included the evaluation of subsurface soils and on and off-site deep groundwater. Surface soil risks were previously addressed in the OUA ROD. The ecological baseline risk assessment included the evaluation of surface water and sediment in Cold Creek. Burnt Bridge Creek was not included in the risk assessment since it was concluded that the Site was not significantly contributing contaminants to the creek. Human and ecological receptors included the following:

- A hypothetical on-site residential child and adult using on-site deep groundwater as a drinking water source (potential future scenario);

- A hypothetical off-site residential child and adult living hydraulically downgradient of the Site who could be exposed to groundwater contaminants via hypothetical deep drinking water wells (potential future scenario);

- An on-site worker exposed to contaminated soils for a limited time during excavation, construction, or demolition activities (potential industrial scenario), and;

- Aquatic species inhabiting the surface water and sediment of Cold Creek. Potential surface water and sediment exposures to humans were considered insignificant.

The hypothetical future on-site resident scenario for exposure to subsurface soils associated with the Fog Chamber Dump Areas and the Cold Creek Fill was not included in the risk assessment because of BPA's future land use plans. The BPA facility will be at this location into the foreseeable future, therefore, the on-site resident scenario is not considered a realistic scenario. The Cold Creek Fill area has physical construction limitations that will preclude residential development. The construction of residences over the trenches was not considered realistic. This constraint is also incorporated into BPA's long range plan for the Site.

The results of the risk assessments were used to decide whether remedial action is necessary and then used in the feasibility study for selection of cleanup guidelines to protect human health and the environment.

The approach followed for both the human health and ecological baseline risk assessment consisted of the following general steps: (1) identification of compounds of potential concern, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization.

7.1 COMPOUNDS OF CONCERN AND USE OF DATA

Compounds of concern were selected from a broader list of chemicals detected based on comparison with natural and area background soil concentrations, prevalence, and toxicity as provided for in the Washington Model Toxics Control Act (MTCA), and EPA regional and national guidance (EPA 1988, EPA 1991). Of potential concern identified by the compounds of concern selected for inclusion in the risk assessment are as follows:

Soils

- metals: antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc

- HPAHs: total HPAHs including benzo(a)anthracene, chrysene, pyrene, benzo(b)fluoroanthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, flouranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene; benzo(a)pyrene was individually evaluated.

- Pesticides/herbicides: 2,4-D; 2,4,5-T; diuron; chlorpropham; and carbofuran

- pentachlorophenol

- Total PCBs

- Total PCDDs/PCDFs (Only for the Fog Chamber Dump Trench Area 1)

On-Site Deep Ground Water

- VOCs: 1,1,1-trichloroethane (TCA); 1,1-dichloroethene (DCE); and chloroform

Off-Site Deep Ground Water

- VOCs: DCE and chloroform

Surface Water/Sediment (ecological exposures only)

- Metals: antimony, barium, cadmium, chromium, copper, lead, and zinc

- Polycyclic Aromatic Hydrocarbons (low and high molecular weight)

- VOCs: TCA, DCE, and DCA

- Pentachlorophenol

- Pesticides/herbicides: 2,4-D, bromacil, dicamba, diuron, propham, and simazine

These compounds of concern were carried throughout the baseline risk assessment and were considered in the Feasibility Study. Because of the general prevalence of these compounds at OUB and known toxicological properties, quantitative evaluation of these compounds was expected to account for greater than 95 percent of all potential Site risk. Accordingly, these compounds of concern were used in the risk assessment in calculation of exposures and characterization of risk.

Samples with chemicals reported as undetected were assumed to contain these constituents at 1/2 the sample quantitation limit for the purpose of calculating averages, as recommended by EPA guidance (EPA, 1989a). The baseline risk assessment was conducted for all chemical data sets based on the 95 percent upper confidence limit (UCL) of the average concentrations. The 95th UCL is utilized at the reasonable maximum exposure (RME) value used in the risk assessment. The RME is defined as the highest potential exposure expected to occur at a site (EPA, 1989a).

7.2 HUMAN HEALTH RISK ASSESSMENT

This section summarizes the exposure assessment, toxicity assessment and the risk characterization associated with the compounds of concern evaluated in the human health risk assessment.

7.2.1 Exposure Assessment

The exposure assessment characterizes the general setting in which potential exposures could occur, including the physical setting and accessibility to contaminated areas; defines potentially exposed populations; identifies exposure pathways; and defines the approach for quantifying exposures, including selection of numerical exposure factors and estimation of chemical intake.

7.2.1.1 Site Setting

The exposure assessment emphasizes potential exposures associated with current land use activities, comprising the baseline scenario, both on and around the site. In addition to on-site worker and off-site residential scenarios and in compliance with EPA Region 10 guidelines (EPA, Region 10, 1991), a hypothetical on-site residential scenario, addressing potential exposures to deep groundwater of potential future residents is included in the quantitative risk assessment. This scenario is included because an existing on-site well is designated as an emergency drinking water well. However, it is not likely, given the presumed continued land use designation of the BPA Ross Complex as a power distribution facility, that groundwater at the site will ever be used as a drinking water source.

The area surrounding the Site exhibits a variety of land uses. These include residential (south, southwest, and southeast), light commercial/industrial (east and northeast), major highways and thoroughfares (west (primarily), north, east (secondarily)), and open space (north, southeast, west). Exposure scenarios are consistent with this diversity of land use.

7.2.1.2 Potentially Exposed Populations

The human receptor groups that were evaluated in the baseline risk assessment included on-site workers and hypothetical on-site residents and off-site residents using hypothetical off-site deep wells as drinking water sources. Table 7 provides a description and summary of the various human receptor groups (both on- and off-site) considered for the baseline risk assessment.

Occupational Receptors

The Cold Creek Fill and Fog Chamber Dump Trench Areas 1 and 2 are historical subsurface waste disposal areas and are not active operational areas of the facility. Therefore, the most plausible exposures to on-site workers would occur during excavation or construction/demolition activities, and only for a limited period of time. Exposures are not expected for workers on a routine basis, which would require consideration of lifetime or long-term exposure duration.

Table 7
Selection of Potential Exposure Pathways by Receptor
BPA Ross Complex RI, OUB

Potential Receptor	Route, Medium, and Point of Exposure	Selected for Quantitative Evaluation?	Basis for Selection or Exclusion On-site/Off-site?
Hypothetical On-Site and Off-Site Residents	Incidental ingestion of soils	No	OUB soils are not accessible to residents.
	Dermal contact with soils	No	OUB soils are not accessible to residents.
	Ingestion of groundwater	Yes	Assumes that residents draw from and use deep groundwater as domestic drinking water supply.
	Inhalation of organic vapors during showering or bathing.	Yes	Assumes that residents draw from and use deep groundwater as domestic drinking water supply.
	Incidental ingestion, dermal contact or ingestion of fish/shellfish from surface water or sediment from Cold Creek.	No	Cold Creek is not a viable pathway for wading, swimming or fishing.
	Ingestion of groundwater by off-site residents.	Yes	Assumes that downgradiant residents draw from and use deep groundwater as domestic water supply.
	Inhalation of organic vapors by off-site residents during showering or bathing.	Yes	Assumes that downgradiant residents draw from and use deep groundwater as domestic water supply.
	Inhalation of vapor-phase chemicals emitted from site.	No	Considered highly unlikely, because intensive field investigation has shown no evidence of volatile organics near OUB soil surfaces.
Ross Complex workers	Incidental ingestion of soils during work activites.	Yes	This pathway assumes that workers could be exposed to soils during excavation or construction activities.
	Dermal contact with soils during work activites.	Yes	This pathway assumes that workers could be exposed to soils during excavation or construction activities.
	Ingestion of groundwater.	Yes	Workers are assumed to have access to groundwater as a drinking water source during work activities. Site is served by City of Vancouver water system and on-site well is auxillary for emergency use only.
	Incidental ingestion or dermal contact of surface water or sediment from Cold Creek during work activities.	No	Workers are not expected to work in Cold Creek area.
	Inhalation of wind-borne particulates or vapor-phase chemicals from exposed soils.	No	Not expected to represent a plausible pathway.

Residential Receptors

Although currently no residents inhabit the Site nor are they foreseen in the future, for the purposes of the Baseline Risk Assessment (RA) hypothetical residents were assumed to inhabit the Site and to have access to the deep (Troutdale) groundwater underlying the Site as represented by the Dittmer auxiliary well, an existing well designed to supply emergency drinking water to the complex. Due to insufficient yield, perched shallow water was not considered a drinking water resource and therefore was not included in the baseline risk assessment.

Consistent with the OUA baseline risk assessment, two residential receptor "age-classes" were evaluated, consisting of "children" (defined as ranging from birth to age 6) and "adults" (defined as ranging from age 6 to 70). This distinction is useful to effectively address the different types of behaviors affecting potential exposures within human populations. This is consistent with numerous studies of human behavior as well as physiological characteristics which suggest that children should be evaluated separately from adults. The on-site worker was also considered as a potential receptor, since access to the Dittmer Well is a potential current and future scenario.

The plausible off-site human "receptors" are residents living hydraulically downgradient of the Site who could be exposed to groundwater contaminants via hypothetical drinking water well(s). These hypothetical off-site resident receptors include an adult and child and were evaluated in the OUB risk assessment for exposures to deep groundwater.

7.2.1.3 Identification of Exposure Pathways

As defined by EPA (1989a), complete contaminant exposure pathways evaluated as part of risk assessment must satisfy the following elements:

- Sources from which chemical contaminants can be released to the environment;
- Environmental transport media (e.g., soil, water);
- Points of potential human contact with the contaminated media; and
- Routes of contaminant entry into human receptors (typically via ingestion, dermal contact, or inhalation).

Groundwater pathways evaluated included ingestion of groundwater from wells located on- and off-site or inhalation of contaminants released from the groundwater during bathing/showering, when the heated, turbulent water is known to increase rates of volatilization and consequent potential for inhalation. Soil pathways (on-site only) consisted of direct contact with or incidental ingestion of soils during hypothetical play or work activities.

Table 7 depicts the rationale for selection of the potential exposure pathways for each of the three receptor groups (off-site residents, on-site workers, and hypothetical on-site residents) including route, medium and exposure point, and basis for selection. The following subsections provide a brief discussion of the rationale for selection of each pathway by specific medium.

Subsurface Soil

The risk assessment has been designed to consider estimated risk levels at specific depths in order to determine the most likely depths at which hazards or risks would occur. Three soil strata were defined for the Baseline RA based on examination of contaminant distribution data within individual OUB soil borings. Soil stratum for both Fog Chamber Dump Areas consists of data points from the surface extending to a depth of 5 feet; the second stratum consists of data points from 6 feet to 15 feet; and the third stratum extends to a depth of 60 feet. Cold Creek Fill soil stratum depths include 0 feet, 5 to 25 feet, and 30 to 60 feet bgs. Although soil samples were taken at greater depths than 60 feet, it was reasoned that if risks/hazards were inconsequential at 60 feet or less it would be unnecessary to estimate risks for greater depths. This is consistent with the OUB soil data, which suggest that contamination levels are insignificant below this depth.

Groundwater

Deep aquifer (Troutdale) groundwater was presumed to be used in the future by hypothetical residents living on-site. These exposures were represented by the Dittmer well, which is situated in an area of known groundwater contamination. Off-site groundwater exposures to Troutdale groundwater were represented by modeled concentrations for two hypothetical downgradient wells: one located southwest of the site in an area of residential land use, the other west-southwest across Interstate 5 from the Site, the nearest likely area where a well could be installed. The locations of the hypothetical off-site wells (HW-1 and HW-2) are shown in Figure 2.

Shallow groundwater exposures were considered for human receptors but were regarded as implausible based on site hydrogeology. The low potential yield of the shallow wells on the eastern portion of the Site reduces the likelihood for a pathway for exposure of on-site workers or hypothetical residents. In addition, shallow groundwater discharges into Cold Creek and the yield of the occurrence of residual contamination in groundwater is limited in extent. Therefore, the ecological exposures from Cold Creek surface water and sediments were also evaluated considering shallow groundwater seepage to the creek or upon past discharges directly into the creek.

Surface Water/Sediments

Potential surface water and sediment exposures were considered insignificant and not plausible for human receptors. Initial calculations concerning hypothetical surface water exposures to children during play activities were performed, however, and indicated that risk levels would be negligible. In addition, risks from surface water and sediment exposures were considered in the OUA risk assessment and contributed negligibly to overall risks as compared to other pathways. The aquatic life inhabiting the creek and its environs was addressed as part of the ecological risk assessment only.

7.2.2 Toxicity Assessment

This section summarizes the toxicological basis for all compound-specific toxicity criteria required to conduct the baseline risk assessment. These criteria, based on available quantified dose-response toxicity data, are developed and reviewed within various offices of EPA. Summaries of the basis from which toxicological values were derived are presented below.

7.2.2.1 Non-Carcinogenic Effects

For non-carcinogenic chemicals, the reference doses (RfD) are used as benchmarks for toxic endpoints of concern. The goal in developing a RfD is to identify the highest no-observed-adverse-effect level (NOAEL) or the lowest-observed-adverse-effect-level (LOAEL) from well-designed human or animal studies. Uncertainty factors from 1 to 1,000 are incorporated to adjust this level based on the following considerations: 1) the duration of the experimental exposure, 2) effects elicited (if any), 3) extrapolation of the data to other species (such as extrapolation from animals to humans), and 4) sensitive subgroups. Additional modifying factors varying between 1 and 10 may also be incorporated in the derivation of the RfD if additional considerations are necessary. RfD and slope factors for the BPA risk assessment were taken from EPA's computerized Integrated Risk Information System (IRIS); Health Effects Assessment Summary Tables (HEAST); Drinking Water Health Advisories; or personal communication with EPA Region X Risk Assessment staff.

The toxicological characterization of compounds of concern was generally confined to chronic (i.e., lifetime) rather than acute or subchronic exposures. This characterization is consistent with the contaminant concentrations found on-site, EPA guidance (EPA, 1989), and exposures likely to occur on the Site.

7.2.2.2 Carcinogenic Effects

For carcinogenic chemicals, slope factors are estimated using a conservative mathematical model which estimates the relationship between experimental exposure (i.e., doses) and the development of cancer (i.e., response) that is derived from human or animal studies. Since there is much uncertainty in the dose-response values generated using this procedure, the upper 95 percent confidence limit of the slope of the dose-response curve is normally used in deriving the slope factor.

7.2.3 Risk Characterization

The exposure and toxicity assessments form the basis for the characterization of chemical risks posed by the Site. Carcinogenic risk is estimated as the incremental probability of an individual developing cancer in excess of the normal background population incidence over a lifetime as a result of exposure to a chemical either known or suspected to cause cancer. To estimate cancer risk, slope factors are combined with site exposure information to estimate the incremental cancer risk, which represents a probability of contracting cancer, and which is usually expressed in scientific notation (e.g., 1E-04). An excess lifetime risk of 1E-04 indicates that, as a plausible upper bound, an individual has a one-in-ten-thousand chance of developing cancer in a lifetime as a result of site-related exposure to a carcinogen.

For known or suspected carcinogens, CERCLA defines acceptable exposures are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 1E-04 and 1E-06, using information on the relationship between dose and response (NCP, 1990).

For non-carcinogens, the measure used to describe the potential for toxicity in an individual is not expressed as a probability. The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specific period (e.g., lifetime) with a reference dose derived for a similar exposure period. This ratio of exposure to toxicity is called a Hazard Quotient. The Hazard Index (HI) is the sum of more than one hazard quotient for multiple substances and/or multiple exposure pathways. Potential non-carcinogenic effects may be of concern if the HI exceeds unity (i.e., HI > 1).

7.2.4 On-Site Risk

Subsurface Soils

Table 8 provides the hazard quotient (HQ) values and cancer risk levels calculated for non-carcinogenic and carcinogenic compounds (respectively) of concern to workers potentially exposed during excavation or construction in the Fog Chamber Dump Trench Areas 1 and 2 and the Cold Creek Fill subsurface soil contaminants.

Fog Chamber Dump, Trench Area 1

The average total cancer risk estimate for exposure carcinogens to construction workers for Trench Area 1 was 7.4E-05, which is within the "acceptable" upper bound risk range of 1.0E-04 to 1.0E-06; however, the RME cancer risk estimate, 9.4E-04, was above the acceptable risk range (Table 8). At least 99 percent of this exposure is accounted for by elevated total PCB concentrations found in subsurface soils (maximum and 95 percent UCL concentrations of 30,000 mg/kg and 1,700 mg/kg respectively). These values were the result of two samples collected in this dump area. Of the two pathways considered (incidental ingestion and direct soil contact), direct soil contact and consequent dermal absorption accounted for the majority of the total RME exposure. For example, some 77 percent of the total projected exposure to total PCBs would be expected to occur as a result of direct dermal contact. RME cancer risk estimates for construction workers by soil depth stratification indicated that elevated risk associated with PCBs is localized between 0-5 feet (2.3E-03) and 6-15 feet (1.6E-02) (Table 9). RME risk estimates associated with other carcinogens were also localized between 0 and 15 feet and ranged between 1.0E-07 to 1.7E-05.

Fog Chamber Dump, Trench Area 2

None of the non-carcinogenic compounds of potential concern identified in Trench Area 2 exceed the HQ target value of 1.0 (Table 8). Based on data which has been stratified by soil depth (Table 9), however, the HQ value for copper is slightly greater than 1.0 within the top five feet of the surface. About 70% of this exposure would be explained by incidental soil ingestion (Table 9).

Average and RME total cancer risk estimates for the construction worker, 1.5E-07 and 2.5E-06, were within the "acceptable" upperbound cancer risk range (1.0E-04 to 1.0E-06) (Table 8).

Table 8

Estimated Hazard Quotients and Lifetime Cancer Risk from Subchronic Soil Exposures, Worker Scenario

BPA Ross Complex OUB FS

Compound	Construction Worker (average)	Construction Worker (RME)
Fog Chamber Dump Trench 1		
Hazard Quotient		
Antimony	< 0.01	0.02
Barium	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01
Copper	< 0.01	0.09
Chromium	< 0.01	< 0.01
Lead	< 0.01	0.16
Mercury	< 0.01	< 0.01
Nickel	< 0.01	< 0.01
Silver	< 0.01	0.01
Zinc	< 0.01	< 0.01
Toluene	< 0.01	< 0.01
Xylene	< 0.01	< 0.01
2,4,5-T	< 0.01	< 0.01
2,4-D	< 0.01	< 0.01
Carbofuran	< 0.01	< 0.01
Chlorpropham	< 0.01	< 0.01
Diuron	< 0.01	< 0.01
Carcinogens		
Arsenic	<1.0E-07	1.2E-07
1,1,2,2-TCA	<1.0E-07	<1.0E-07
Pentachlorophenol	<1.0E-07	<1.0E-07
Benzo(a)anthracene	<1.0E-07	<1.0E-07
Benzo(a)pyrene	<1.0E-07	3.4E-07
Benzo(b)fluoranthene	<1.0E-07	<1.0E-07
Benzo(ghi)perylene	<1.0E-07	<1.0E-07
Benzo(k)fluoranthene	<1.0E-07	<1.0E-07
Chrysene	<1.0E-07	<1.0E-07
Dibenzo(ah)anthracene	<1.0E-07	1.2E-07
Indeno(123cd)pyrene	<1.0E-07	<1.0E-07
Total HPAHs	<1.0E-07	1.1E-06
Total PCBs	7.4E-05	9.3E-04
Dioxin	2.5E-07	7.0E-06
Total Risk (except total HPAHs) =	7.42E-05	9.40E-04
Fog Chamber Dump Trench 2		
Hazard Quotient		
Antimony	< 0.01	0.01
Barium	< 0.01	< 0.01
Cadmium	< 0.01	< 0.01
Copper	0.05	0.33
Chromium	< 0.01	< 0.01
Lead	0.02	0.25
Mercury	< 0.01	< 0.01
Nickel	< 0.01	< 0.01
Zinc	< 0.01	< 0.01
Acetone	< 0.01	< 0.01
Methylene Chloride	< 0.01	< 0.01
Toluene	< 0.01	< 0.01
Xylene	< 0.01	< 0.01
Chlorpropham	< 0.01	< 0.01

Table 8
Estimated Hazard Quotients and Lifetime Cancer Risk from Subchronic Soil Exposures, Worker Scenario
BPA Ross Complex OUB FS

Compound	Construction Worker (average)	(RME)
Carcinogens		
Arsenic	<1.0E-07	2.8E-07
Methylene chloride	<1.0E-07	<1.0E-07
Benzo(a)anthracene	<1.0E-07	<1.0E-07
Benzo(a)pyrene	<1.0E-07	2.4E-07
Benzo(b)fluoranthene	<1.0E-07	<1.0E-07
Benzo(ghi)perylene	<1.0E-07	<1.0E-07
Benzo(k)fluoranthene	<1.0E-07	<1.0E-07
Chrysene	<1.0E-07	<1.0E-07
Dibenzo(ah)anthracene	<1.0E-07	<1.0E-07
Indeno(123cd)pyrene	<1.0E-07	<1.0E-07
Total HPAHs	<1.0E-07	4.5E-07
Total PCBs	<1.0E-07	1.6E-07
Dioxin	<1.0E-07	1.7E-06
Total Risk (except total HPAHs) =	1.54E-07	2.46E-06
Cold Creek Fill		
Hazard Quotient		
Barium	< 0.01	< 0.01
Copper	< 0.01	0.01
Chromium	< 0.01	< 0.01
Lead	< 0.01	< 0.01
Mercury	< 0.01	< 0.01
Nickel	< 0.01	< 0.01
Zinc	< 0.01	< 0.01
Acetone	< 0.01	< 0.01
MIBK	< 0.01	< 0.01
Toluene	< 0.01	< 0.01
Xylene	< 0.01	< 0.01
Chlorpropham	< 0.01	< 0.01
Carcinogens		
Arsenic	<1.0E-07	1.5E-07
Pentachlorophenol	<1.0E-07	<1.0E-07
Benzo(a)anthracene	<1.0E-07	<1.0E-07
Benzo(a)pyrene	<1.0E-07	<1.0E-07
Benzo(b)fluoranthene	<1.0E-07	<1.0E-07
Benzo(ghi)perylene	<1.0E-07	<1.0E-07
Benzo(k)fluoranthene	<1.0E-07	<1.0E-07
Chrysene	<1.0E-07	<1.0E-07
Dibenzo(ah)anthracene	<1.0E-07	<1.0E-07
Indeno(123cd)pyrene	<1.0E-07	<1.0E-07
Total HPAHs	<1.0E-07	9.7E-08
Total PCBs	<1.0E-07	5.4E-07
Total Risk (except total HPAHs) =	9.12E-08	8.17E-07

Table 9
Estimated Hazard Quotients and Lifetime Cancer Risk For Specific Soil Strata, Worker Scenario
BPA Ross Complex OUB FS

Compound	Depth	Workers (average)	Workers (RME)
Fog Chamber Dump Trench 1			
Hazard Quotient			
Antimony	0-5'	< 0.01	0.28
	6-15'	< 0.01	0.05
	16-25'	< 0.01	< 0.01
Barium	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	0.01
	16-25'	< 0.01	< 0.01
Cadmium	0-5'	< 0.01	0.01
	6-15'	< 0.01	0.01
	16-25'	< 0.01	< 0.01
Copper	0-5'	0.01	0.15
	6-15'	< 0.01	0.08
	16-25'	< 0.01	< 0.01
Chromium	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25'	< 0.01	< 0.01
Lead	0-5'	0.01	0.28
	6-15'	< 0.01	0.13
	16-25'	< 0.01	< 0.01
Mercury	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25'	< 0.01	< 0.01
Nickel	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25'	< 0.01	< 0.01
Silver	0-5'	< 0.01	0.01
	6-15'	< 0.01	< 0.01
	16-25'	< 0.01	< 0.01
Zinc	0-5'	< 0.01	0.01
	6-15'	< 0.01	< 0.01
	16-25'	< 0.01	< 0.01
Toluene	0-5' (U)	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25' (U)	< 0.01	< 0.01
Xylene	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25' (U)	< 0.01	< 0.01
2,4,5-T	0-5'	< 0.01	< 0.01
	6-15' (U)	< 0.01	< 0.01
	16-25'	< 0.01	< 0.01
2,4-D	0-5'	< 0.01	< 0.01
	6-15' (U)	< 0.01	< 0.01
	16-25' (U)	< 0.01	< 0.01
Carbofuran	0-5'	< 0.01	< 0.01
	6-15' (U)	< 0.01	< 0.01
	16-25' (U)	< 0.01	< 0.01
Chlorpropham	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25' (U)	< 0.01	< 0.01
Diuron	0-5'	< 0.01	< 0.01
	6-15'	< 0.01	< 0.01
	16-25' (U)	< 0.01	< 0.01

Table 9

Estimated Hazard Quotients and Lifetime Cancer Risk For Specific Soil Strata, Worker Scenario
BPA Ross Complex OUB FS

Compound	Depth	Workers (average)	Workers (RME)
Carcinogens			
Arsenic	0-5'	<1.0E-07	2.1E-06
	6-15'	<1.0E-07	1.5E-06
	16-25'	<1.0E-07	<1.0E-07
1,1,2,2-TCA	0-5' (U)	<1.0E-07	<1.0E-07
	6-15'	<1.0E-07	<1.0E-07
	16-25' (U)	<1.0E-07	<1.0E-07
Pentachlorophenol	0-5'	<1.0E-07	<1.0E-07
	6-15' (U)	<1.0E-07	<1.0E-07
	16-25' (U)	<1.0E-07	<1.0E-07
Benzo(a)pyrene	0-5'	<1.0E-07	2.9E-06
	6-15'	<1.0E-07	5.0E-06
	16-25' (U)	<1.0E-07	<1.0E-07
Total HPAHs	0-5'	<1.0E-07	6.7E-06
	6-15'	1.5E-07	1.7E-05
	16-25'	<1.0E-07	1.1E-06
Total PCBs	0-5'	2.9E-05	2.3E-03
	6-15'	1.7E-04	1.6E-02
	16-25'	<1.0E-07	1.4E-06
Dioxin	2-5'	2.5E-07	2.4E-06
	8-11'	2.5E-07	<1.0E-07
	composite	2.5E-07	7.0E-06
Fog Chamber Dump Trench 2			
Hazard Quotient			
Antimony	1-5'	< 0.01	0.04
	7-11' (U)	< 0.01	< 0.01
Barium	1-5'	< 0.01	0.01
	7-11'	< 0.01	< 0.01
Cadmium	1-5'	< 0.01	0.01
	7-11' (U)	< 0.01	< 0.01
Copper	1-5'	0.03	1.02
	7-11'	< 0.01	< 0.01
Chromium	1-5'	< 0.01	< 0.01
	7-11'	< 0.01	< 0.01
Lead	1-5'	0.03	0.54
	7-11'	< 0.01	0.00
Mercury	1-5'	< 0.01	< 0.01
	7-11' (U)	< 0.01	< 0.01
Nickel	1-5'	< 0.01	< 0.01
	7-11'	< 0.01	< 0.01
Zinc	1-5'	< 0.01	0.01
	7-11'	< 0.01	< 0.01
Acetone	1-5'	< 0.01	< 0.01
	7-11' (U)	< 0.01	< 0.01
Methylene Chloride	1-5'	< 0.01	< 0.01
	7-11' (U)	< 0.01	< 0.01
Toluene	1-5'	< 0.01	< 0.01
	7-11'	< 0.01	< 0.01
Xylene	1-5'	< 0.01	< 0.01
	7-11' (U)	< 0.01	< 0.01
Chlorpropham	1-5'	< 0.01	< 0.01
	7-11' (U)	< 0.01	< 0.01

Table 9

Estimated Hazard Quotients and Lifetime Cancer Risk For Specific Soil Strata, Worker Scenario
BPA Ross Complex OUB FS

Compound	Depth	Workers (average)	(RME)
Carcinogens	-	-	-
Arsenic	1-5'	<1.0E-07	1.7E-06
	7-11'	<1.0E-07	6.3E-07
Methylene chloride	1-5'	<1.0E-07	<1.0E-07
	7-11' (U)	<1.0E-07	<1.0E-07
Benzo(a)pyrene	1-5'	<1.0E-07	1.4E-06
	7-11'	<1.0E-07	<1.0E-07
Total HPAHs	1-5'	<1.0E-07	2.5E-06
	7-11'	<1.0E-07	<1.0E-07
Total PCBs	1-5'	<1.0E-07	4.0E-07
	7-11' (U)	<1.0E-07	1.0E-07
Dioxin	1-3'	<1.0E-07	1.7E-06
	5-7'	<1.0E-07	<1.0E-07
Cold Creek Fill			
Hazard Quotient			
Barium	0'	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Copper	0'	< 0.01	0.04
	5-25'	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Chromium	0'	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Lead	0'	< 0.01	0.01
	5-25'	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Mercury	0'	< 0.01	< 0.01
	5-25' (U)	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Nickel	0'	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Zinc	0'	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60'	< 0.01	< 0.01
Acetone	0' (U)	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60' (U)	< 0.01	< 0.01
MIBK	0' (U)	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60' (U)	< 0.01	< 0.01
Toluene	0' (U)	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60' (U)	< 0.01	< 0.01
Xylene	0'	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60' (U)	< 0.01	< 0.01
Chlorpropham	0' (U)	< 0.01	< 0.01
	5-25'	< 0.01	< 0.01
	30-60' (U)	< 0.01	< 0.01

Table 9

Estimated Hazard Quotients and Lifetime Cancer Risk For Specific Soil Strata, Worker Scenario
BPA Ross Complex OUB FS

Compound	Depth	Workers (average)	Workers (RME)
Carcinogens			
Arsenic	0'	<1.0E-07	1.0E-06
	5-25'	<1.0E-07	<1.0E-07
	30-60'	<1.0E-07	9.8E-08
Benzo(a)pyrene	0'	<1.0E-07	1.5E-07
	5-25'	<1.0E-07	1.7E-07
	30-60'	<1.0E-07	<1.0E-07
Total HPAHs	0'	<1.0E-07	3.2E-07
	5-25'	<1.0E-07	5.0E-07
	30-60'	<1.0E-07	<1.0E-07
Total PCBs	0'	1.1E-07	2.7E-06
	5-25'	<1.0E-07	1.7E-06
	30-60'	<1.0E-07	1.4E-07

Cold Creek Fill Area

None of the non-carcinogenic compounds of potential concern exceed or approach the HQ target value of 1.0 (Table 8). Depth-stratified risk levels are also below 1.0 (Table 9).

Calculated average and RME risk values for surface and subsurface soils at the Cold Creek Fill do not indicate elevated risk levels from sub-chronic exposures to soil by construction workers (average and RME cumulative carcinogenic risk levels of 9.1E-08 and 8.2E-07, respectively).

On-Site Deep Groundwater

Table 9 provides the hazard quotient (HQ) values and cancer risk levels calculated for non-carcinogenic and carcinogenic compounds, respectively, of potential concern for hypothetical on-site residential receptors (adult and child) and on-site workers potentially exposed to contaminants in groundwater. Results are reported based on the cumulative average and 95 percent upper confidence limits for each contaminant and RME exposure scenarios by compound and receptor.

Table 10 indicates that the HQ values calculated to address non-carcinogenic exposures of TCA, DCE, or chloroform were below the target value of 1.0, which suggests that measured concentrations are well below levels of toxicological concern.

The estimated cancer risk estimates for the three on-site receptors were within the "acceptable" upperbound cancer risk guideline of 1.0E-04 to 1.0E-06. Calculated cancer risk levels for the hypothetical on-site residential child, for cumulative average and RME values were 1.6E-05 and 4.4E-05, respectively. Calculated cancer risk levels for hypothetical on-site adults, representing cumulative average and RME values were 4.6E-06 and 5.0E-06, respectively. Calculated cancer risk levels for on-site workers, representing cumulative average and RME values were 4.1E-07 and 1.2E-06, respectively. Most of these calculated risk levels are virtually completely accounted for by the presence of DCE in groundwater. These calculated risk levels for the other suspected carcinogen, chloroform, for on-site residents were in the 1.0E-07 range (less than 1 percent of the total). Of the two pathways considered, drinking water ingestion accounted for at least 97 percent of the total exposure; inhalation was not found to be a significant factor.

7.2.4.1 Evaluation of Off-Site Risks

Off-Site Deep Groundwater

The calculated total cancer risk levels for the hypothetical off-site residential adult and child based on exposure to hydraulically downgradient deep groundwater from the off-site hypothetical well #1 (HW-1) is provided on Table 11. The risk assessments are based on modeled concentrations for DCE and chloroform based on current conditions. The total cancer risk estimates for the off-site hypothetical adult is 1.38E-05 and for the child is 1.34E-05, which is within the "acceptable" cancer risk range of 1.0E-04 to 1.0E-06.

Table 10

Estimated Hazard Quotients and Lifetime Cancer Risk From On-Site Groundwater, Hypothetical On-Site Residents and Workers
BPA Ross Complex OUB FS

Compound	Hypothetical Adult (average)	Hypothetical Adult (RME)	Hypothetical Child (average)	Hypothetical Child (RME)	Worker (average)	Worker (RME)
Hazard Quotient						
1,1,1-TCA	<0.01	0.01	0.01	0.03	<0.01	<0.01
1,1-DCE	0.01	0.02	0.03	0.09	<0.01	<0.01
Chloroform	<0.01	0.02	0.02	0.08	<0.01	<0.01
Carcinogens						
1,1-DCE	4.9E-06	4.5E-05	1.6E-05	4.4E-05	4.0E-07	1.2E-06
Chloroform	<1.0E-07	6.2E-07	1.5E-07	6.0E-07	<1.0E-07	<1.0E-07
Total Carcinogenic Risk =	5.0E-06	4.6E-05	1.6E-05	4.4E-05	4.1E-07	1.2E-06

Table 11

Estimated Hazard Quotients and Lifetime Cancer Risk to Off-Site Groundwater, Hypothetical On-Site Residents (a)
BPA Ross Complex OUB FS

Compound	Hypothetical Adult (RME)	Hypothetical Child (RME)
Hypothetical Well (HW-1)		
Hazard Quotient		
1,1-DCE	0.01	0.03
Chloroform	0.01	0.04
Carcinogenic Risks		
1,1-DCE	1.35E-05	1.31E-05
Chloroform	3.11E-07	3.00E-07
Total Carcinogenic Risk =	1.38E-05	1.34E-05
Hypothetical Well (HW-2)		
Hazard Quotient		
1,1-DCE	0.00	0.02
Chloroform	0.01	0.04
Carcinogenic Risks		
1,1-DCE	9.02E-06	8.71E-06
Chloroform	3.00E-07	2.90E-07
Total Carcinogenic Risk =	9.32E-06	9.00E-06

Footnote:
(a) Modeled downgradient groundwater concentrations calculated to be 0.003 mg/l for chloroform and 0.0018 mg/l for 1,1-DCE for HW-1, and 0.0029 mg/l for chloroform and 0.0012 mg/l for 1,1-DCE for HW-2.

The total cancer risk estimates for the hypothetical off-site adult and child associated with exposure to hydraulically downgradient deep groundwater from the off-site hypothetical well #2 (HW-2) is also provided in Table 11. Assumptions made to model groundwater contaminant concentrations downgradient of the Site were conservative. Total cancer risk estimates for the off-site hypothetical adult and child is 9.3E-06 and 9.0E-06, respectively. The concentrations are within the acceptable cancer risk range of 1.0E-04 to 1.0E-06.

7.2.5 Uncertainty

Major components of the assessment which decreased the certainty of other results were 1) the toxicity reference values used, and the lack of values for several chemicals; 2) limitations in contaminant concentration data for soils and ground water; 3) the inclusion of concentrations at a level one-half the detection limit for many chemicals; and 4) the use of a number of assumptions to establish exposure parameters in computing chemical intakes.

Due to uncertainty in these and other areas, conservative assumptions were made in order to ensure protection of human health. Cancer and non-cancer risk estimates must be carefully interpreted, particularly when evaluating non-carcinogenic effects where uncertainty factors of two to three orders of magnitude are used in dose-response assessments.

Although most parameters addressed and included in the baseline risk assessment are inexact, all are designed to be conservative and therefore, are protective of all receptors considered.

7.3 ECOLOGICAL RISK ASSESSMENT

The purpose of the ecological risk assessment was to characterize ecological hazard or risk to terrestrial or aquatic receptors. Aquatic life was considered the most conservative receptor since they cannot easily avoid contaminated water as compared to terrestrial life. Conditions protective of aquatic receptors were presumed to be protective of terrestrial wildlife that could use Cold Creek as a drinking water source. The baseline ecological risk assessment was an evaluation of the potential threats to the environment from the Site in the absence of any remedial action and focused on potential exposures to aquatic life inhabiting the surface water and sediments of Cold Creek. A reasonable maximum exposure (RME) was used to address potential ecological exposures.

The toxicological properties of the surface water and sediment indicator compounds were reviewed, and benchmark values were derived to address chronic toxicity to aquatic life. EPA Ambient Water Quality Criteria (AWQC), which have been established for the general protection of aquatic life, represent a high quality body of aquatic regulations based solely on toxicity data acquired from numerous diverse studies on specific aquatic contaminants. Chronic AWQC were used when available as benchmark values for surface water in the ecological risk assessment. Where chronic toxicity AWQC values were not available, they were estimated based on acute toxicity data. Since numerical freshwater sediment quality criteria have not been established, dose-response data from various studies were used to address sediment toxicity for the protection of sediment-dwelling organisms. The ecological hazard for exposure to sediment included normalizing the organic benchmark values to an assumed total organic carbon (TOC) content of one percent.

7.3.1 Risk Characterization

Aquatic ecological risks were estimated for each chemical in which the downstream average concentration in water and sediment (Stations SW-4 and SED-4) exceeded the upstream (Stations SW-1 and SED-1) average concentrations. The ecological hazard quotient (HQ) for aquatic life (receptors) was estimated as the average water and sediment concentration from Cold Creek divided by the Ambient Water Quality Criteria or appropriate toxicological benchmark value (Table 12).

All of the remaining individual HQ values fall below 1.0, the threshold level of concern. Aquatic organisms in Cold Creek are therefore not likely to be at risk as a result of exposure to the average concentrations in water and sediment identified at Station SW-4 and SED-4.

Table 12

Hazard Quotients for Aquatic Receptors
Downstream Unfiltered Water (N= 6) and Filtered Water (N=4)
BPA Ross Complex OUB RI (Downstream = Site 4)

Chemicals evaluated are those for which the downstream maximum exceeded the upstream maximum

Concentrations in ug/L.	Freshwater Chronic Criterion (a)	Average Downstream Concentration (SW-4)	Maximum Upstream Concentration (SW-1) (b)	Hazard Quotient
Trace metals, total				
Aluminum	NA	961	1760	NA
Arsenic	48	1	4 U	0.03
Barium	NA	29	50 U	NA
Chromium (assumed hexavalent)	11.0	4	6 UJ	0.38
Cobalt	NA	2	3 U	NA
Iron	NA	2471	2580 J	NA
Magnesium	NA	9693	10300	NA
Manganese	NA	363	200	NA
Potassium	NA	2363	2390	NA
Sodium	NA	6827	7200	NA
Vanadium	NA	14	10	NA
Zinc	106	33	34	0.31
Trace metals, dissolved				
Aluminum	NA	11	121	NA
Arsenic	48	1 U	2 U	0.02
Barium	NA	13	14	NA
Chromium IV	11.0	0.2 U	6 U	0.02
Cobalt	NA	3 U	3 U	NA
Iron	NA	177	143	NA
Magnesium	NA	10423	10,300	NA
Manganese	NA	115	7	NA
Potassium	NA	2393	2,390	NA
Sodium	NA	7168	7,200	NA
Vanadium	NA	8	9	NA
Zinc	106	3	9	0.03
Polycyclic Aromatic Hydrocarbons (PAH)				
HPAH (high molecular weight)				
Benzo(a)pyrene	0.2	6.50E-03	0.01 U	0.03
Benzo(a)anthracene	0.2	1.03E-02	0.01 U	0.05
Chrysene	0.2	1.88E-02	0.021	0.09
Benzo(b)fluoranthene	0.2	1.97E-02	0.012	0.10
Benzo(k)fluoranthene	0.2	6.33E-03	0.01 U	0.03
Benzo(g,h,i) perylene	0.2	1.18E-02	0.02 U	0.06
Fluorene	0.2	1.00E-02	0.01 U	0.05
Indeno(1,2,3-cd)pyrene	0.2	1.33E-02	0.02 U	0.07
Fluoranthene	159.2	7.25E-02	0.016	0.00
Pyrene	79.6	3.57E-02	0.032	0.00
Misc. BNAs				
Propham	264	0.9	1 U	0.00

FOOTNOTES

NA = not applicable, generally because neither freshwater acute nor chronic AWQC's exist for this compound

(a) Origin and derivation of these values are shown on Table 7-13.

(b) Upstream contaminant data represented by Station C-SW1.

8.0 REMEDIAL ACTION OBJECTIVES

Remedial action is required to protect human health and the environment at the Fog Chamber Dump Trench Area 1 and Trench Area 2. The following findings of the remedial investigation and baseline risk assessment support the need for remedial action in these areas:

- At the Fog Chamber Dump Trench Area 1, there is a 2.3E-03 risk to on-site workers associated with exposure to subsurface soils. PCBs were detected at concentrations of 30,000 ppm at six to fifteen feet below ground surface. This contributes significantly to the risks associated with Fog Chamber Dump Trench Area 1. High levels of metals (lead, arsenic and copper) were detected in various locations.

- In Fog Chamber Dump Trench Area 2 soils containing up to 16,000 ppm of lead were identified as well as significantly elevated levels of other metals (copper, arsenic, zinc and antimony)

The results of the RI indicated that Burnt Bridge Creek, Cold Creek and the Cold Creek Fill Area do not pose unacceptable risks to human health or the environment, therefore no action is necessary at these areas.

The results of the RI also indicated the presence of low levels of TCA, DCE and chloroform in the shallow perched water table and the deep aquifer. The shallow perched water table at the site is not considered a usable source of drinking water due to insufficient yield; therefore, it was not included in the baseline risk assessment. The occurrence of DCE and chloroform in the deep groundwater does not pose an unacceptable risk to human health or the environment and does not require remediation. However, the MCL for DCE is slightly exceeded in one on-site deep monitoring well and the deep Troutdale aquifer is used extensively as a drinking water resource. Therefore, BPA will continue to monitor groundwater contaminant concentrations on-site in both shallow and deep monitoring wells.

The specific goals and objectives of the remedial action at the Fog Chamber Dump Trench Areas 1 and 2 are:

- To prevent direct contact with contaminated soil;
- To prevent future disturbance of contaminated soil;
- To prevent surface water infiltration, and;
- To create an area at Fog Chamber Dump Trench Area 1 that can be used by BPA for storage of heavy equipment.

9.0 DESCRIPTION OF ALTERNATIVES

Six alternatives were initially evaluated for soil remediation at the Fog Chamber Dump Trench Areas 1 and 2. The approximated volume of soil that requires remediation include 2,160 cubic yards in Trench Area 1 and 16,666 cubic yards in Trench Area 2. The general response actions initially considered for soil remediation alternatives for Operable Unit B included:

- Alternative A - No Action,
- Alternative B - Limited Excavation and Off-Site Disposal,
- Alternative C - In-Situ Vitrification
- Alternative D - Capping with Institutional Controls,
- Alternative E - Ex-Situ Treatment and Disposal, and
- Alternative F - Institutional Controls

9.1 ALTERNATIVE A - NO ACTION

The No Action alternative is required by the National Contingency Plan (NCP) and serves as a baseline against which other soil remedial alternatives can be compared. Under this alternative, no remedial activities would take place. This alternative does not protect the public health or mitigate unacceptable environmental risks associated with the contamination.

9.2 ALTERNATIVE B - LIMITED EXCAVATION WITH OFF-SITE DISPOSAL

Contaminated areas that exceed clean up levels would be excavated. Debris and soil would be sorted into separate waste streams. The material would be disposed in an approved off-site landfill. Confirmatory sampling would be conducted following excavation to ensure that the contamination has been removed. Although an attempt to remove all contaminated material above the cleanup levels would be performed, it is likely that residual contamination would remain due to the nature of the waste disposal in the dump areas.

9.3 ALTERNATIVE C - IN-SITU VITRIFICATION

Contaminated soil would be treated using in-situ vitrification, a thermal treatment technology which oxidizes organic contaminants and physically binds inorganic contaminants into a glass-like substance that is resistant to leaching. Gaseous emissions generated during processing are confined and drawn through the hood for cooling, scrubbing, filtering, and chemical treatment. Vitrified material would be left in place and any subsidence above the vitrified mass would be refilled with clean fill. The surface would then be paved or revegetated.

9.4 ALTERNATIVE D - CAPPING WITH INSTITUTIONAL CONTROLS

This alternative involves the placing of a cap over the contaminated area. The cap would control erosion, eliminate human contact and minimize the infiltration of water into the contaminated material. Institutional controls would restrict access and limit future land use. For the Fog Chamber Dump, Trench Area 1, an estimated area of 8,025 square feet will be capped. Three cap designs for Trench 1 were evaluated including: 1.) Resource, Conservation and Recovery Act (RCRA) cap with clay layer and soil surface; 2.) Minimal Functional Standards (MFS) cap; and 3.) crushed rock surface. A RCRA cap is used to contain RCRA hazardous waste. The subsurface soil contamination in Trench 1 would not be a RCRA hazardous waste because it was disposed prior to 1980 and it would not be moved or "actively managed". Although a RCRA cap would not be required, it is included in the evaluation as the most restrictive cap and therefore provides a basis for comparison.

A Minimum Functional Standard (MFS) cap is designed to satisfy the State of Washington public health and safety requirements (RCW 70.95.075) for solid waste landfills. The intent of the MFS cap is to minimize surface water and groundwater contamination associated with contaminated subsurface soil. The cap design includes the use of a liner over the waste material with sand and geotextile fabric overlain by crushed rock.

The crushed rock surface cap design is the least restrictive of the three options and does not meet RCRA or MFS cap design criteria. This design overlies a crushed rock surface over the waste material. This cap can be used when contaminated material poses a low risk through human contact, surface water infiltration, and groundwater contamination.

Only one cap design was evaluated in the FS for the Fog Chamber Dump, Trench 2. Evaluation included a RCRA cap with a clay layer and soil surface (Option 1). The most restrictive cap design alternative was selected for cost evaluation purposes only.

9.5 ALTERNATIVE E - EX-SITU TREATMENT AND DISPOSAL

All contaminated areas would be excavated and debris and soil would be separated similar to Alternative B, Limited Excavation with Off-Site Disposal. Separated metal objects would be sent off-site for recycling, and solid waste that was not a hazardous waste would be disposed at an off-site solid waste landfill. Hazardous waste would either be disposed off-site at an approved landfill, or incinerated off-site and disposed in an approved landfill.

9.6 ALTERNATIVE F - INSTITUTIONAL CONTROLS

This alternative includes the measures to limit or prohibit activities that may interfere with or disturb contaminated areas and includes long-term monitoring of soils. Measures employed as institutional controls would include access restrictions, deed restrictions, and land use restrictions. Access restrictions are designed to prevent unauthorized access to areas where contamination is present and would consist of fencing, signs, and roadway modifications. Deed and land use restrictions would limit future land use and prohibit disturbance of soil.

9.7 ALTERNATIVES RETAINED FOR DETAILED EVALUATION

The following alternatives were retained for detailed analysis based on the results of the initial screening.

Fog Chamber Dump - Trench Area 1

- Alternative A - No Action,
- Alternative B - Limited Excavation with Off-Site Disposal
- Alternative D - Capping with Institutional Controls

- Alternative E - Ex-Situ Treatment and Disposal

- Alternative F - Institutional Controls

Fog Chamber Dump, Trench Area 2

- Alternative A - No Action

- Alternative B - Limited Excavation with Off-Site Disposal

- Alternative D - Capping with Institutional Controls

- Alternative F - Institutional Controls

Alternative C - In-Situ Vitrification was screened out for further analysis in both the Fog Chamber Dump, Trench Areas 1 and 2 because of the difficulties involved in implementation and prohibitive costs. Alternative E, Ex-Situ Treatment and Disposal, was also screened out for further analysis in Trench Area 2 due to the prohibitive costs.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives for each waste unit were compared according to nine criteria as defined and required by the NCP. The nine criteria are subdivided into three categories: (1) threshold criteria which relate directly to statutory findings and must be satisfied by each chosen alternative; (2) primary balancing criteria, which include technical factors; and (3) modifying criteria, which are measures of the acceptability of the alternative to state agencies and the community.

All alternatives must meet the threshold criteria of overall protection of human health and the environment and compliance with ARARs. The chart illustrated in Figure 7 shows the relationship between the screening criteria, the nine evaluation criteria, and the role of the criteria during remedy selection. The following sections present the comparison of alternatives.

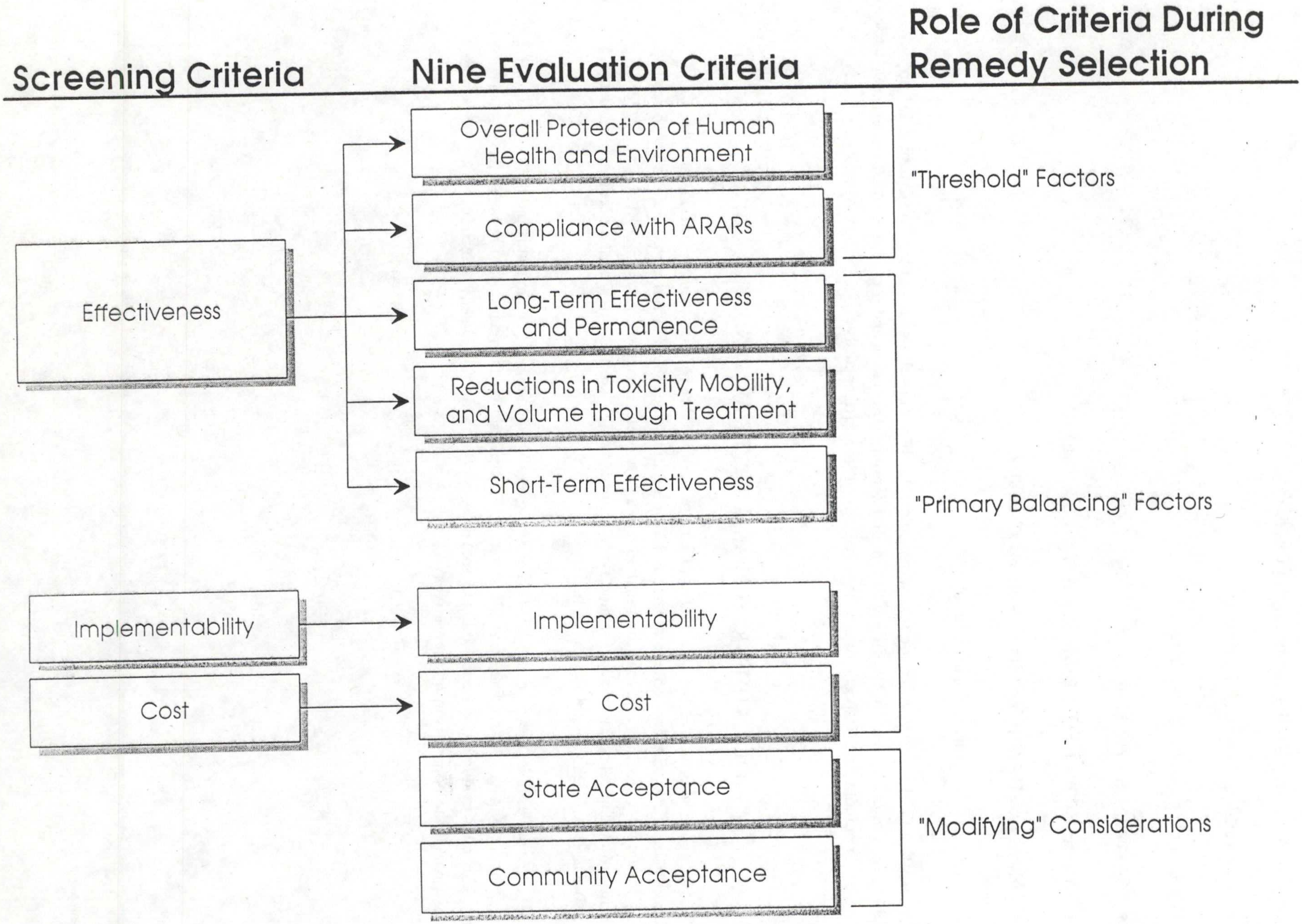


Figure 7

Relationship of Screening Criteria

10.1 COMPARATIVE ANALYSIS FOR FOG CHAMBER DUMP, TRENCH AREA 1

Target Contaminants: PCBs, Metals, HPAHs
Soil Volume: 2,160 cubic yards

10.1.1 Threshold Criteria

10.1.1.1 Overall Protection of Human Health and the Environment

This criterion measures how the alternative, as a whole, achieves and maintains protection of human health and the environment.

Alternative A, No Action, does not provide protection to human health or the environment and does not prevent the migration of contaminants since no remedial activities would take place to reduce exposures to contaminants. Since Alternative A is not protective, it will not be further evaluated.

Alternative B, Limited Excavation with Off-Site Disposal, offers a higher level of overall protection than Alternatives A, D and F through the removal of contaminated materials from the Site. Contaminated materials would be transported to an approved landfill for disposal.

Alternative D, Capping with Institutional Controls, offers a level of overall protection higher than Alternative A through both the construction of a cap and site restrictions designed to prevent exposure to contaminants.

Alternative E, Ex-Situ Treatment and Disposal offers the highest level of protection as compared to Alternatives A, D, and F by removing contaminants from the site, treating the material off-site and disposing of the material in an approved landfill.

Alternative B, Limited Excavation with Off-Site Disposal, is similar to Alternative E through the excavation and removal of contamination. The majority of the contaminated soil would be removed; however, due to the nature of the disposal, it is likely that residual contamination would remain.

Alternative F, Institutional Controls, offers a slightly greater level of protection than Alternative A through site restrictions designed to prevent exposure to contaminated material. However, Alternative F is not as protective as Alternatives B, D and E.

10.1.1.2 Compliance with ARARs

Compliance with ARARs is a consideration of how the alternatives comply with other regulations explicitly applicable to the site and with those sufficiently relevant and appropriate to warrant inclusion.

Alternative B, Limited Excavation with Off-Site Disposal and E, Ex-Situ Treatment and Disposal, would be required to meet transport and handling ARARs and would comply with the Southwest Air Pollution

Control Agency's (SWAPCA) general standards for maximum air emissions during the actual excavation and treatment. MTCA cleanup levels would be met.

Alternative D, Capping with Institutional Controls, would comply with the Minimal Functional Standards (MFS) ARARs for capping landfills since high levels of contamination would be left in place and would comply with the MTCA.

Alternative F would comply with MTCA requirements to prevent contact and exposure.

10.1.2 Primary Balancing Criteria

10.1.2.1 Long-Term Effectiveness and Permanence

This criterion evaluates the long-term effectiveness and permanence of alternatives in maintaining protection of human health and the environment after remedial action objectives have been met.

Alternative B, Limited Excavation with Off-Site Disposal, and Alternative E, Ex-Situ Treatment and Disposal, have a high degree of long-term effectiveness and permanence. These alternatives minimize the risks associated with contaminated soils by their removal from the Site. Due to the distribution of the waste disposal activities in the dump areas, it is likely that residual waste would remain. Residual risk to the on-site worker would not represent an unacceptable cancer risk.

Alternative D, Capping with Institutional Controls, would be slightly more effective than Alternative F but less effective than Alternative B. Under this alternative, contaminants would be left in place and a cap would be installed over them. This cap would prevent exposure to the contamination. The permanence of Alternative D would depend on the effectiveness of institutional controls and on long-term maintenance of the cap. Residual risk to the on-site worker would not represent an unacceptable cancer risk.

Alternative F, Institutional Controls, controls long-term risks by minimizing the potential for disturbance of contaminated materials. This alternative requires the facility to maintain the institutional controls and ensure that restrictions are enforced.

10.1.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives were also evaluated according to their ability to reduce, through treatment, the toxicity, mobility, or volume of contaminants.

There is no treatment associated with Alternatives B, C, or D. Although these alternatives do not meet MTCA's preference for treatment, in the case of landfills, excavation of waste often creates more environmental harm than good.

Alternative E, Ex-Situ Treatment and Disposal, is the only alternative that includes treatment. Following excavation, solid debris would be separated from soil and debris would be further sorted into four waste stream categories: non-hazardous waste, hazardous waste, material requiring disposal, incineration or treatment, and recyclable material. This alternative includes an incineration component of various waste stream categories which offers greater reduction through treatment as compared to Alternatives B, C or D.

10.1.2.3 Short-Term Effectiveness

This criterion addresses the effects of the alternative during the construction and implementation phase until remedial action objectives are met.

Alternative B, Limited Excavation with Off-Site Disposal, and Alternative E, Ex-Situ Treatment and Disposal, present more potential for increased short-term risk to the community, workers, and the environment due to the potential exposure to dust generated during excavation as compared to Alternatives D or F. These risks can be effectively controlled using standard dust suppression methods, personnel protective equipment and through the implementation of a health and safety plan. Additional risks would include physical hazards associated with construction and transportation risks related to the transport of contaminated material to appropriate landfills. These risks would be eliminated after the implementation of the alternative which is expected to require eight weeks. This time frame is longer than Alternative F, but less than Alternative D. Measures to control the risks would be implemented prior to excavation.

Alternative D, Capping with Institutional Controls, would present a lower short-term risk than Alternatives B and E. The potential risk would be present only during the spreading of base course materials over the contaminated surface which may generate a potential exposure to dust; however, this risk could be effectively controlled. Time to implement this alternative is approximately three months.

Alternative F, Institutional Controls, would not present additional short-term risk because contaminated materials would not be disturbed. Site restrictions would be implemented in about two weeks and deed and other land use restrictions would be implemented thereafter.

10.1.2.4 Implementability

This criterion addresses the technical and administration feasibility of constructing, operating, and maintaining a remedial action alternative.

Alternative E, Ex-Situ Treatment and Disposal, is the most difficult to implement due to the need for excavating, sorting transporting, and incinerating or disposing of landfilled soil and debris. Alternative B, Limited Excavation with Off-Site Disposal, is less difficult to implement as compared to Alternative E since the excavated material would not be sorted.

Alternative D, Capping with Institutional Controls, is readily implementable as compared to Alternatives B, Limited Excavation and Off-Site Disposal and E, Ex-Situ Treatment and Disposal since labor and equipment for installation of the cap are readily available and capping technology is common and widely used.

Alternative F is the easiest to implement as compared to Alternative B, D, and E since obtaining deed and land-use restrictions require only administrative procedures.

10.1.2.5 Cost

Cost is another criterion by which candidate alternatives are compared. Costs in this case are measured as total present worth costs. The present worth costs which include both capital and operation and maintenance costs for the remedial alternatives at the Fog Chamber Dump, Trench Area 1 for 2,160 cubic yards of contaminated soil is as follows:

Alternative	**Present Worth Cost**
Alternative B - Limited Excavation with Off-Site Disposal	$2,087,270
° Assumes 2,160 cubic yards excavated with residual contamination left in place.	
Alternative D - Capping with Institutional Controls	
Option 1: RCRA Cap, Clay Layer with Soil Surface	$240,000
Option 2: MFS Cap	$150,000
Option 3: Crushed Rock Surface	$130,000
Alternative E - Ex-Situ Treatment and Disposal	
° Assumes 2,160 cubic yards will be excavated	
° Assumes all material is hazardous (includes incineration)	$3,590,000
° Assumes 50 percent is hazardous (includes incineration)	$1,930,000
Alternative F - Institutional Controls	$30,000
° Assumes fencing and signs	

10.1.3 Modifying Criteria

Modifying criteria are used in the final evaluation of the remedial alternatives, and include input from Ecology and from the public.

10.1.3.1 State Acceptance

The State of Washington concurs with the selected remedy and comments received from Ecology have been incorporated into this Record of Decision.

10.1.3.2 Community Acceptance

Based on the comments received during the public review period and at the public meeting, the public accepts the preferred alternative.

10.2 FOG CHAMBER DUMP TRENCH AREA 2

Target Contaminant: HPAHs and metals
Soil Volume: 16,666 cubic yards

10.2.1 Threshold Criteria

10.2.1.1 Overall Protection of Human Health and the Environment

Alternative A, No Action, does not provide protection to human health or the environment since no remedial activities would take place. Since Alternative A is not protective, it will not be further evaluated.

Alternative B, Limited Excavation with Off-Site Disposal, offers a higher level of protection as compared to Alternatives A, D, and F by removing contaminants from the site and disposing of the material in an approved landfill; however, residual contaminants would likely be left in place due to the nature of the waste disposal in this area.

Alternatives D, Capping with Institutional Controls, offers a greater level of protection as compared to Alternative A through construction of a cap and site restrictions that are designed to prevent exposure to contaminants.

Alternative F, Institutional Controls, offers a greater level of protection as compared to Alternative A, through site restrictions designed to prevent exposure to contaminants. However, Alternative F is not as protective as Alternatives B and D.

10.2.1.2 Compliance with ARARs

Alternative B, Limited Excavation with Off-Site Disposal, would be required to meet transport, handling, and disposal ARARs. Alternative D, Capping with Institutional Controls would have to comply with ARARs for capping landfills and MTCA requirements but would not meet the soil cleanup levels identified for the site under Alternatives C and E.

Alternative F will comply with MTCA requirements to prevent contact; however, it would not meet the soil cleanup levels identified for the site under Alternatives B, C, and E.

10.2.2 Primary Balancing Criteria

10.2.2.1 Long-term Effectiveness

Alternative B, Excavation with Off-Site Disposal, has the highest degree of long-term effectiveness and permanence. This alternative reduces the risks associated with contaminated soils by excavating and transporting soils off site to an approved landfill. Due to the nature of the disposal area, it is likely that residual contamination will be left in place. Residual risks to the on-site worker will not represent an unacceptable cancer risk.

Alternative D, Capping with Institutional Controls, has a lower degree of long-term effectiveness as compared to Alternative B; however, a high degree of effectiveness and permanence can be achieved through design and operations and maintenance. Residual risks to the on-site worker will not represent an unacceptable cancer risk.

Alternative F, Institutional Controls, is more effective than the No Action alternative. Site restrictions would minimize the potential for disturbance of contaminated soils as long as the controls are maintained and enforced. This alternative will not represent an unacceptable cancer risk to the on-site worker.

10.2.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

No alternative includes treatment.

10.2.2.3 Short-Term Effectiveness

Alternative B, Limited Excavation with Off-Site Disposal, and Alternative E, Ex-Situ Treatment with Off-Site Disposal, may involve short-term risk to on-site workers, the community, and the environment from exposure to dust generated during the excavation of soil. These risks can be effectively controlled using standard dust suppression methods, personnel protective equipment and through the implementation of a health and safety plan. Additional risks would include physical hazards associated with construction and transportation risks related to the transport of contaminated material to appropriate landfills.

Alternative F, Institutional Controls, would not result in additional short-term risks since no remedial activities would take place and contaminated materials would not be disturbed. It would take approximately one week for installation of site restrictions and about three months to implement deed restrictions and land-use restrictions.

Alternative D, Capping with Institutional Controls, would involve a lower short-term risk to on-site workers, the community, and the environment from exposure to dust generated during capping activities as compared to Alternative B and E since contaminated soil would not be disturbed. Alternative D can control the risk within 3 months.

10.2.2.4 Implementability

Alternative B is the most difficult to implement due to the need for limiting screening and sorting, transporting, and treating and disposing of landfilled materials.

Alternative D, Capping with Institutional Controls, is less difficult to implement than Alternative B due to readily available capping materials and the cap is compatible with BPA future use of this area.

Alternative F is easier to implement than Alternatives B and D due to the need to only obtain deed and land-use restrictions which are readily available.

10.2.2.5 Cost

The estimated cost of each soil cleanup alternative, based on the present worth costs capital including capital and operation and maintenance costs and for remediating 16,666 cubic yards of contaminated material in the Fog Chamber Dump Trench Area 2:

Alternative	Present Worth Cost
Alternative B - Limited Excavation with Off-Site Disposal	$3,098,785
Alternative D - Capping with Institutional Controls (RCRA Cap)	$120,000
Alternative F - Institutional Controls	$5,000

° Assumes the use of signs

10.2.3 Modifying Criteria

10.2.3.1 State Acceptance

The State concurs with the selected remedy and comments received from Ecology have been incorporated into this Record of Decision.

10.2.3.2 Community Acceptance

Based on the comments received during the public review period and at the public meeting, the public accepts the proposed alternative.

11.0 SELECTED REMEDY

11.1 KEY ELEMENTS OF SELECTED REMEDY FOR FOG CHAMBER DUMP TRENCH AREA 1

Based upon consideration of the requirements of CERCLA and state requirements, the detailed analysis of the alternatives using the nine criteria, and public comments, the most appropriate remedy for the Fog Chamber Dump, Trench Area 1, is MFS Capping with Institutional Controls (Alternative D). This alternative provides protection of human health and the environment and can be implemented at a lower cost than any of the other alternatives. The Fog Chamber Dump, Trench Area 1, contains soil contaminant concentrations above state cleanup levels between 1.5 feet and up to 20 feet deep. The MFS cap was selected because the cap design provides protection of human health by eliminating the potential for contact and minimizes surface water infiltration that could lead to groundwater contamination. Contaminated soils in Trench Area 1 are not a RCRA hazardous waste; therefore, the RCRA cap design option was not selected. The crushed rock surface cap does not satisfy MFS regulations and therefore, cannot be selected. Institutional controls will be used to restrict access to this area by fencing, deed, and land use restrictions; implementation will eliminate the potential for future disturbance of contaminated material. The Ross Complex Site Manager is responsible for ensuring that the institutional controls are maintained at the Site.

Major components of the selected remedy includes:

- A MFS cap that consists of a impervious liner over a 1.5 foot layer of clean fill material directly overlying the waste. The cap will consist of a protective layer of sand, followed by a geotextile fabric overlain by crushed rock.
- Institutional controls that consist of a fence with signs to restrict access and deed and land use restrictions.

11.2 KEY ELEMENTS OF SELECTED REMEDY FOR FOG CHAMBER DUMP TRENCH AREA 2

Based upon consideration of the requirements of CERCLA and state requirements, the detailed analysis of the alternatives using the nine criteria, and public comments, the selected remedy for the compound of concern in the Fog Chamber Dump, Trench Area 2, is Institutional Controls. This alternative provides protection of human health and the environment and can be implemented at a lower cost than any other of the alternatives. The Fog Chamber Dump, Trench Area 2, contains soil contaminant concentrations that exceed state cleanup levels between 1.5 feet and 3.5 feet deep. Solid waste such as wires and cables coated with lead were encountered in the waste material. Contaminant concentrations are considered to be associated with solid waste rather than from waste generated by industrial processes. While the risk assessment determined that this area did not pose an unacceptable risk under the current land use scenario, there are metal concentrations that exceed MTCA cleanup levels significantly in the soil at isolated locations associated with debris. Approximately 1.5 feet of clean fill material overlies the waste material and contains a vegetative cover. BPA's intended use of this area is for training purposes. Since the subsurface contamination is limited in extent and does not represent a risk to human health or the environment through direct contact or to ground water, Alternative F, Institutional Controls, is the selected alternative for the Fog Chamber Dump Trench 2. Institutional controls will be used to restrict land use activities through deed and land use restrictions that may disturb subsurface contamination. If a need arises to excavate in this area in the future, BPA will sample the soils and properly dispose of contaminated soil in accordance with state and federal regulations.

11.3 KEY ELEMENTS FOR THE COLD CREEK FILL

Based upon the results of the RI it was determined that the existing conditions at the Site were protective of public health and the environment, therefore no further action is required for the Cold Creek Fill Area. The Cold Creek Fill Area is an engineered fill that has been continually filled, compacted and graded overtime with soil obtained from construction projects on the Complex. The upper sequence of the fill contains clean fill material obtained from recent construction activities on the Complex. Soil contaminant concentrations above the clean up levels were found in limited isolated locations between 5 and 25 feet bgs but were not laterally extensive. Migration of contamination is unlikely in this area since the types of contaminants are relatively immobile and soils in this area contain low permeability characteristics due to engineered controls. Access to this area is restricted by fencing on the north and south sides and is topographically restricted on the west side which serves as a barrier for egress and ingress. Furthermore, BPA's intended future use of this area is for construction material and equipment storage as defined in the long term plans for the site. Accordingly, no further action is required for the Cold Creek Fill Area.

11.4 KEY ELEMENTS FOR SITE GROUNDWATER

Based upon the results of the RI, consideration of the requirements of CERCLA, and public comments, BPA will continue to monitor for the presence of volatile organic compounds in the shallow perched water table and the deep aquifer. The residual occurrence of volatile organic does not constitute an on-site or off-site risk to human health and the environment. Since a groundwater contaminant source was not identified by the RI, groundwater will continue to be monitored to determine if the concentration will go up, down, or remain stable. The additional groundwater monitoring is for five years and the chemical parameters, monitoring wells, and schedule are provided below. BPA may petition for discontinuing, narrowing, or reducing the sample frequency after two years, depending on the results. EPA, BPA and Ecology will jointly evaluate the data to determine what, if any, continued monitoring or additional action may be necessary.

Biannual Monitoring	Monitoring Wells
TCA, DCE, Chloroform	MW-4A, MW-13B, MW-14B, MW-16B

Biannual monitoring (twice/year) will include both a wet and dry season. The approximate costs for groundwater monitoring is $15,000 per year.

11.5 KEY ELEMENTS FOR COLD CREEK AND BURNT BRIDGE CREEK

Based upon consideration of the requirements of CERCLA, state requirements and public comments, no further action is required for surface water and sediments in Cold Creek and Burnt Bridge Creek.

12.0 STATUTORY DETERMINATION

BPA and EPA's primary responsibility under CERCLA, is to ensure that the selected remedy will protect human health and the environment. Additionally, Section 121 of CERCLA, as amended by SARA, establishes several other statutory requirements and preferences. These specify that, when complete, the selected remedy must comply with applicable and relevant or appropriate environmental standards established under federal and state environmental laws unless a waiver is justified.

The selected remedy must also be cost-effective and utilize permanent solutions or resource recovery technologies to the maximum extent practicable. The remedy should represent the best balance of tradeoffs among the alternatives with respect to pertinent criteria. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element.

The selected remedies for the contaminated soil at the Fog Chamber Dump Trench Areas 1 and 2 meet the statutory requirements.

12.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy for the Fog Chamber Dump, Trench Area 1 will protect human health and the environment through isolating the contaminants and through restricting surface water infiltration from the site. Engineering controls will be utilized during the cap installation that will eliminate the potential for exposure to dust. There will be no adverse effects on human health and the environment caused by construction and implementation of the selected remedy. The cap will provide long-term effectiveness through operation and maintenance activities.

The selected remedy for the Fog Chamber Dump Trench Area 2 is considered protective of human health and the environment since use of the area will be restricted, 1.5 feet of clean fill material overlies the waste, and the contaminants contain low mobility characteristics. Land use and deed restriction will prohibit future disturbance of this area.

12.2 COMPLIANCE WITH ARARs

The selected remedy of capping with institutional controls in the Fog Chamber Dump, Trench Area 1 and institutional controls in the Fog Chamber Dump, Trench Area 2 will comply with the ARARs presented in the following list.

- Requirements of Washington Model Toxics Control Act (Initiative 97) for clean up of hazardous waste sites, Chapter 70.105 RCW, as codified in Chapter 173-340 WAC;

- Requirements of State of Washington Public Health and Safety Requirement, RCW 70.95.075 as codified in Chapter 173-304 WAC for solid waste landfills, and;

- General emission standards under WAC 173-400-040 for visible emissions, fugitive emissions and emissions of air contaminants which are detrimental to persons or property.

12.2.1 Other Criteria, Advisories, or Guidance To-Be-Considered (TBC)

No other criteria, advisory, or guidance are considered necessary for implementation of the selected remedies.

12.3 COST EFFECTIVENESS

The selected remedies are the most cost effective alternative because they protect human health and the environment, attain ARARs, and meet the objectives established for the remedial action in a way that is proportional to their costs. The cost of the other alternatives evaluated were substantially higher and significantly disproportionate as compared to the cost and benefits of the selected remedy at the Fog Chamber Dump, Trench Area 1 and Trench Area 2.

12.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES

The selected remedy represents the maximum extent to which permanent solutions can be utilized in a cost-effective manner at the BPA Ross Complex. The selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, volume achieved through treatment, short-term effectiveness, and cost.

12.5 PREFERENCE FOR TREATMENT AS PRINCIPAL ELEMENT

The size of the trench areas and the nature of the contamination preclude a remedy in which contaminants could be excavated and treated safely and effectively. Therefore, because treatment was not found to be practicable, the selected remedies do not meet the statutory preference for treatment.

13.0 DOCUMENTATION OF SIGNIFICANT CHANGES

There are no significant changes pertaining to OUB since the Proposed Plan was released for public comment on June 25, 1993.

ATTACHMENT I
RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY
OPERABLE UNIT B
BONNEVILLE POWER ADMINISTRATION
ROSS COMPLEX

This responsiveness summary addresses the questions and comments received by the Bonneville Power Administration concerning the Proposed Plan related to subsurface soil remediation and continued groundwater monitoring for Operable Unit B at the Ross Complex located in Vancouver, Washington. The Site was listed on the National Priorities List (NPL) in November 1989 based on the presence of volatile organic compounds in groundwater and the Site's proximity to the City of Vancouver's drinking water supply. As a results of the listing BPA, pursuant to a Federal Facility Agreement signed by BPA, EPA, and the Washington Department of Ecology (Ecology) on May 1, 1990, BPA conducted a Remedial Investigation/Feasibility Study (RI/FS) to determine the nature and extent of contamination at the site and to evaluate alternatives for the clean up of contaminated areas.

On May 1, 1991, a community relations plan (CRP) was prepared by BPA's Community Relations Group in accordance with CERCLA, as amended by SARA. The CRP included establishing information repositories and communication pathways to disseminate information. Information repositories are located at both the Ross Complex and in the Vancouver Regional Library, 1007 East Mill Plane Boulevard, Vancouver, Washington 98663.

An administrative record was established to provide the basis for selection of the remedial action in accordance with section 113 of CERCLA. The administrative record is available for public review at the Ross Complex or the Vancouver Regional Library. During the RI/FS, BPA issued a press release and five additional fact sheets. The chronology of the community relations is listed below.

- May 22, 1990 — A scoping meeting was held to provide information to the public and hear concerns about environmental conditions at the site.
- July 1990 — Fact sheet No. 4 described the results of the May scoping meeting.
- March 1991 — Fact sheet No. 5 described chronology of events and the work plan for the RI/FS.
- May 1991 — Fact sheet No. 6 described the RI and FS programs and current site work.
- August 1991 — Fact sheet No. 7 described status of the RI field work.
- May 1992 — Fact sheet No. 8 defined Operable Units A and B, discussed OUA RI and risk assessment findings, and activities planned for the summer of 1992.

- August — A Proposed Plan for Remedial Action of OUA was mailed to the public. The plan described proposed remedial actions and selected remedies for OUA soils.

- September 1992 — A public meeting was held to present the findings of the RI/FS for Operable Unit A and the selected remedial alternatives outlined in the Proposed Plan for Operable Unit A.

- May 1993 — Fact sheet No. 9 described the results of the RI for Operable Units A and B, that groundwater was not a public threat and gave advance notice of the upcoming July 1993 public meeting.

- June 1993 — Proposed Plan for OUB Remedial Action of OUB was mailed to the public. The plan described proposed remedial alternatives and selected remedies for OUB soil groundwater, surface water and sediment.

- July 1993 — A public meeting was held to present the findings of the RI/FS for Operable Unit B and the selected remedial alternatives outlined in the Proposed Plan for Operable Unit B.

The public was given the opportunity to participate in the remedy selection process in accordance with sections 117 and 113(k)(2)(B) of CERCLA. The Proposed Plan for Operable Unit B, which summarized the alternatives evaluated and presented the preferred alternative, was mailed to approximately 800 interested parties on June 24, 1993. BPA provided public notice through display ads in the Columbian and Oregonian on June 22, 1993 to explain the Proposed Plan, list the public comment period, and announce the public meeting. Media coverage was also provided in the form of local newspaper articles which appeared on June 2 and 6, 1993 and cable television news coverage on Channel 25 on June 1, 1993 and July 9, 1993.

A 30-day public comment period was held from June 25, 1993 to July 26, 1993. Approximately 20 people attended a public meeting, which was held on July 8, 1993 at the Ross Complex, DOB Auditorium. No verbal comments were received at the public meeting and three written comments are included in the attached Responsiveness Summary.

1. **The Washington State Office of Archaeology and Historic Preservation (OAHP) acknowledges that the Ross Complex is eligible for listing in the National Register of Historic Place. The proposed alternatives for cleaning up contamination will not affect buildings and structures at the Ross Complex which are National Register eligible. In the event properties may be impacted by work associated with this action, OAHP requests consultation.**

Response: It is correct that these remedial actions will not impact structures that may be eligible for the National Register. Should BPA's plans change, OAHP will be alerted.

2. **There is concurrence with the need for ongoing groundwater monitoring.**

Response: No response.

3. **The funds used to publish the Proposed Plan for Operable Unit B would be better used to cleanup the site.**

Response: Communication, with the involvement of the public, is an essential feature of the CERCLA process. BPA is required by law to issue a proposed plan that is available to the public for review and comment.

ATTACHMENT II
ADMINISTRATIVE RECORD LISTING

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ROSS COMPLEX SUPERFUND ADMINISTRATIVE RECORD
OPERABLE UNIT B
BONNEVILLE POWER ADMINISTRATION
VANCOUVER, WASHINGTON

The information contained in the Administrative Record is duplicated in the information repository located in the Vancouver Public Library at 1007 East Mill Plain Blvd. The official Administrative Record will close when the Record of Decision is signed. Information will continue to be added to the information repository at the Vancouver Public Library. This file has been set up following EPA guidelines. Duplication will not be made of information already in Operable Unit A.

5.2 Sampling and Analysis Data

5.3 Engineering Evaluation/Cost Analysis

5.4 Action Memorandum

5.5 Verification

6.0 COORDINATION

6.1 Cooperative Agreements (See Operable Unit A)

6.2 EPA Coordination

6.3 State of Washington Department of Ecology

6.4 U S Department of Energy

7.0 HEALTH ASSESSMENTS

7.1 Interagency Agreement (IAG) DOE/ATSDR

7.2 ATSDR Health Assessments

7.3 Toxicological Profiles

8.0 BPA INTERNAL INFORMATION

8.1 Communications

8.2 Ongoing Site Control

9.0 PUBLIC PARTICIPATION

9.1 Community Relations Plan(See Operable Unit A)

9.2 Public Meetings

9.3 Comments and Responses

9.4 Public Notices/Press Releases

9.4.1 Press Conferences/Releases

9.4.2 News Articles

9.5 Fact Sheets

10.0 TECHNICAL SOURCES AND GUIDANCE DOCUMENTS

See Operable Unit A

Administrative Record for Operable Unit B, Ross Complex , Vancouver, WA

FILE	DOC. NO.	TITLE/TYPE	DATE	PAGES	AUTHOR/ORGANIZATION	ADDRESSEE/ORGANIZATION
0.0	0001	**TABLE OF CONTENTS**				
0.1	0001	Operable Unit B Index		1		
1.0		**SITE IDENTIFICATION**				
		See Operable Unit A				
2.0		**REMEDIAL INVESTIGATION (RI)**				
2.1	0001	Draft Work Plan (Oper Unit B)	5/15/92		Dames & Moore	BPA
2.4	0001	Final RI Volume 1 Report	3/19/93	Vol 1	Dames & Moore	BPA
2.4	0001	Final RI Report Appendices Vol 1	3/19/93	App 1	Dames & Moore	BPA
2.4	0001	Final RI Report Appendices Vol 2	3/19/93	App 2	Dames & Moore	BPA
3.0		**FEASIBILITY STUDY (FS)**				
3.0	0001	Feasibility Study	2/12/93		Dames & Moore	BPA
3.3	0001	Proposed Plan	June 93	13	Mailed to Ross Neighborhood/Employees	
4.0		**RECORD OF DECISION (ROD)**				
5.0		**REMEDIAL ACTION**				
5.2.1	0001	Disposal of investigative wastes	5/11/93	76	M. Allen, Dames & Moore	Tony Morrell, BPA
6.0		**COORDINATION**				
6.1		Federal Facilities Agreement			See Operable Unit A	Joint Agreement
6.1.2	0001	Ltr Transmit Draft OUB RI	12/10/92	1	Anthony Morrell, BPA	EPA and Ecology
6.1.2	0002	Ltr Transmit Draft OUB FS	2/12/93	1	Anthony Morrell, BPA	EPA and Ecology
6.1.2	0003	Ltr Transmit Final OUB RI	3/19/93	1	Anthony Morrell, BPA	EPA and Ecology
6.1.2	0004	Ltr Transmit Final OUB FS	5/14/93	1	Anthony Morrell, BPA	EPA and Ecology
6.1.2	0005	Ltr Transmit OUB Proposed Plan	5/14/93	1	Anthony Morrell, BPA	EPA and Ecology
6.1.2	0006	Ltr Transmit Final OUB RI	5/25/93	1	Anthony Morrell, BPA	EPA and Ecology
6.2	0001	Ltr extend RI comment period	1/5/93	1	Nancy Harney, EPA	Tony Morrell, BPA
6.2	0002	Ltr w/comments Draft RI	1/22/93	47	Nancy Harney, EPA	Tony Morrell, BPA
6.2	0003	Ltr respond EPA comments	2/1/93	2	Anthony Morrell, BPA	Nancy Harney, EPA
6.2	0004	Ltr re groundwater modeling	2/10/93	2	Nancy Harney, EPA	Tony Morrell, BPA
6.2	0005	Ltr with Final RI comments	4/16/93	24	Nancy Harney, EPA	Tony Morrell, BPA

Administrative Record for Operable Unit B, Ross Complex , Vancouver, WA

6.2	0006	Ltr re future groundwater monitoring	3/26/93	7	Anthony Morrell, BPA	EPA and Ecology
6.2	0007	Ltr re future groundwater monitoring	4/13/93	2	Nancy Harney, EPA	Tony Morrell, BPA
6.2	0008	Ltr w/updates for OUB Final FS	6/29/93	1	EPA/Ecology	
6.3	0001	Ltr appt Tim Nord-Toxics Cleanup	12/21/92	1	Carol Fleskes, Ecology	David Dunahay, BPA
6.3	0002	Ltr w/comments Draft RI	1/11/93	4	Chris Poindexter, Ecology	Anthony Morrell, BPA
6.3	0003	Ltr w/comments Draft FS	3/12/93	3	Chris Poindexter, Ecology	Anthony Morrell, BPA
6.3	0004	Ltr re future groundwater monitoring	4/6/93	1	Chris Poindexter, Ecology	Anthony Morrell, BPA
6.3	0005	Ltr re EPA's comments on prop plan	6/7/93	2	Chris Poindexter, Ecology	Anthony Morrell, BPA
7.0		**HEALTH ASSESSMENTS**				
8.0		**BPA INTERNAL INFORMATION**				
9.0		**PUBLIC PARTICIPATION**				
9.2	0001	Ross Community Contact List	6/1/93	2	BPA	
9.2	0002	Ltr Notice of 7/8/93 public meeting	6/23/93	1	David Dunahay, BPA	Interested Public/Neighbors
9.3	1001	Public Meeting (7/8/93) Comment Log	7/16/93	48	Interested Neighbors	BPA, Public Involvement
9.3	0002	Official Comment Log Close 7/26/93			Comments	BPA
9.4	0001	Public Meeting ad (7/8/93)	6/22/93	1	The Oregonian	Metro/Northwest
9.4	0002	Public Meeting ad (7/8/93)	6/22/93	1	The Columbian	Northwest
9.5.2	0001	Studies find BPA Site no threat	6/2/93	1	The Oregonian	Clark County
9.5.2	0002	Study: Ground water safe	6/3/93	1	The Columbian	Columbia Country
9.6		Fact Sheet No. 9 Env Studies Done	See AR9.6 OUA 0009			
10.0		**TECHNICAL SOURCES**			See Operable Unit A	
EX.xls						